The Dock & Harbour Authority

No. 463. Vol. XL. MAY, 1959 Monthly 2s. 6d.

ECONOMICAL DREDGING

Following the successful operation of the dredger "*Ketam*", the Marine Department, Federation of Malaya, ordered a similar vessel, the "*Gannet*" for harbour dredging.

With an output of up to 900 tons per day, the working costs are 10d. per ton.

The dimensions of these vessels are 95′ 0″ × 25′ 0″ × 7′ 6″ with a loaded draft of 5′ 6″. Propelled by a Gleniffer engine developing 160 B.H.P. the loaded speed is 7½ knots.

IN OVER 300 OF THE WORLD'S PORTS

PRIESTMAN

PRIESTMAN BROTHERS LIMITED · HULL · ENGLAND

BCA

To Correspondents

All Letters and Contributions intended for Publication should be addressed to the Editor:—K. R. Doggett, Assoc.I.C.E., and must in all cases be accompanied by the name and address of the sender.

To Advertisers

Our circulation is world-wide and we have subscribers in 85 countries. For Advertisement Rates and space particulars apply to the Advertisement Manager.

Subscription Rates

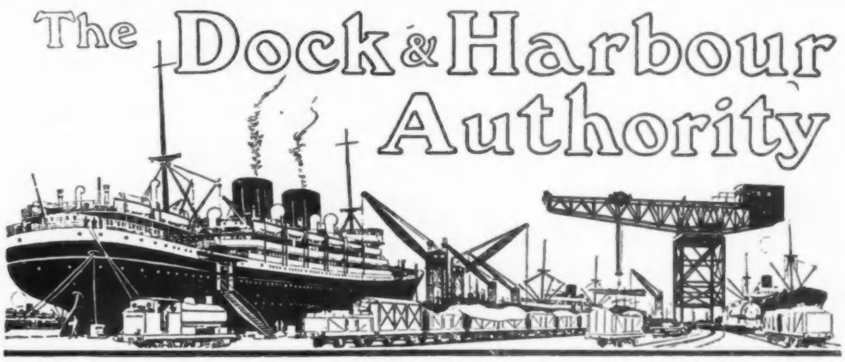
PER 2s. 6d. COPY
(plus 8d. wrapping and postage).

Annual Subscription including postage:—
United Kingdom and Abroad
£1 18s. 0d.
U.S.A. and Canada
$6.00.

Back numbers (when available) are charged double if over 6 months old.

All subscriptions must be Prepaid. Postal Orders and Cheques should be made payable to: "The Dock and Harbour Authority," 19 Harcourt Street, London, W.1.

Telephone: PAD 0077 and 0078.



CONTENTS

The Dock & Harbour Authority

An International Journal with a circulation extending to 85 Maritime Countries

No. 463

Vol. XL

MAY, 1959

Monthly 2s. 6d.

Editorial Notes

Wharf Reconstruction at Rochester, Kent

Because this relatively minor wharf reconstruction scheme is typical of the works carried out by many dock, harbour or river Authorities in the course of their day-to-day work, we are publishing this month a paper by C. G. Cumming, M.I.C.E., describing in detail the design considerations and reconstruction methods for a wharf at Rochester. The paper is of interest in that it describes the improvement, under a modest budget, of an existing reinforced concrete quay to accommodate modern high-capacity wharfside cranes loading coal from ship to quayside railway wagons, the depth of water alongside being 9-ft. below mean low water of spring tides and the tidal range 18-ft. 6-in. The work which included soils investigation and test piling, was carried out without closing the wharf to traffic.

In publishing the paper we would like to acknowledge the many other works of quay reconstruction occasioned by improvements in craneage, berthing drafts and lengths and in ancillary facilities, carried out annually throughout the world under the ubiquitous financial head of modernisation. The majority of these improvements are not reported, except perhaps for a column in the local press, and this is unfortunate as few of these works have no aspect of originality, or are unworthy of technical report. It is therefore a matter of regret that so few of the smaller schemes are honoured by even a brief technical abstract, particularly as in the majority of cases both expediency and the financial importance of careful design so often combine to provide that essential essence termed "good engineering."

Aspects of sound design and construction should be recorded for the benefit of others. We would therefore welcome contributions from our readers.

Australian Stevedoring Industry Authority

One reason why there are so many problems in the port industry is that the range of jobs to be done on ship and quay is not only very wide but is always changing. This is also the reason why embracing schemes, such as the British National Dock Labour Scheme, can only solve a proportion of the labour problems. Port work is not done under standard conditions. Ideally, not only each port but each berth should be able to arrange its own manning, handling methods, piecework rates and working conditions to suit its particular lay-out and construction, its traffic and labour force.

The Australian Stevedoring Industry Authority is only one of the numerous national bodies which are organised to improve port working conditions and to ensure that the best use is made of the available labour. The Australian scheme is a comparatively new one and for this reason the Authority's annual reports are all the more interesting. The functions and duties of the Authority are miscellaneous and numerous. They range from determining roster gang sizes to providing amenities for waterside workers and from prosecuting employers for breaches of the Scheme to assisting with the broad problem of accident prevention. Many sections of the current Report (for 1957/1958) are both interesting and instructive and extracts from them, which appear on a later page of this issue, show that teething troubles are being overcome and experience gained.

Train and Car Ferries

It is frequently the duty of a Port Authority to operate passenger and vehicular ferries across a harbour, river or strait within the area of the Undertaking's jurisdiction. The operation of a train ferry service by a harbour authority is more unusual, such service normally being administered by the State or by a separate transportation service which may or may not control the terminal harbour. Wherever any type of ferry is put into operation, extensive alterations may be necessary to the harbour and quayside facilities in order to accommodate the new service. It is therefore of importance to Dock and Harbour Authorities, including those which may have a statutory obligation to maintain an unprofitable ferry service, that any replacement or development scheme is the best and most efficient available.

We are including in this issue extracts of a paper by Mr. J. P. Campbell on "Train and Car Ferries," which summarises the present factors in design and recent developments of both types of craft, and of the terminal facilities required. Whether for train or vehicles, these ferries and their ancillary services must operate under arduous conditions for prolonged periods with the maximum reliability. The design and equipment of craft and plant for this unspectacular and sometimes unrewarding service therefore deserves the most careful consideration.

Nuclear Propulsion for Surface Ships

Under arrangements made by the Admiralty, a series of papers was recently presented in London by the Atomic Energy Authority and several British nuclear engineering firms on a variety of reactor systems capable of use in surface ships. The audiences comprised members of the Admiralty naval and civilian staff, the Ministry of Transport and Civil Aviation and other Government departments and of the Marine Nuclear Propulsion Committee, which sits under the chairmanship of the Civil Lord of the Admiralty and which comprises representatives of the shipping, shipbuilding and marine engineering industries, Lloyd's Register of Shipping, the Atomic Energy Authority and several Government Departments. The project was organised to inform the British shipping and shipbuilding industries and other interested parties of the present state of nuclear development in the field of ship propulsion.

Papers were read on eight reactor systems which all possess different characteristics in terms such as weight, size, capital and operating costs and other technical factors. Not all of them are equally advanced for early use. The claims made for each have now to be assessed by a technical sub-committee which is to report which system offers the best advantages.

The Ministry of Transport Committee on Marine Nuclear Safety will continue to investigate the problems of safety in nuclear ships and in the ports and harbours which they will use. The goal of the Admiralty Committee is the economic nuclear merchant ship. It is evident that the studies at present in hand are a big step forward.

It is also of interest that, among the reports of the proceedings at the recent Royal Netherlands Industries Fair at Utrecht, a statement was made to the effect that reactor-driven vessels, costing only about 5 per cent more to run than conventional ships will be sailing the oceans in 1961. This view will be considered optimistic by many as, at present, as far as is known, only one ship, the American " Savannah " is actually building and she can hardly be regarded as a commercial proposition. The question of nuclear propulsion is however being studied in many countries in order to keep abreast of any new advances that may be made.

Litigation in the Port Industry

In certain trades, bill of lading conditions put the burden of delivering goods to consignee upon the shipowner.

An instance arose recently where a shipping company's labour contractor, whose employees damaged cargo during course of delivering it to consignee's vehicle, claimed limitation of liability because of a clause in the contract between the cargo owner and the ship owner.

The action, which came before Mr. Justice Diplock in the Queen's Bench Division (Commercial Court), was in the nature of a test case. A report of the reserved judgment given appears on a later page.

Opening of the St. Lawrence Seaway

On the 25th April last, the Canadian icebreaker " d'Iberville " carrying Government and Seaway officials, led a fleet of some 70 vessels into the St. Lawrence Seaway. At the same time, from the western end of the Seaway, 19 Canadian-owned cargo ships started to move from Ogdensburg, New York, towards the Port of Montreal and the Atlantic. So, with little ceremony, what has recently been termed " the fourth seacoast of the North American Continent " became a commercial reality. The official opening of the Seaway by H.M. the Queen and President Eisenhower will be commemorated by a State ceremony on June 26th.

To mark this historic occasion, we propose to publish next month some details of the works entailed in the construction of the Seaway and also a description of a number of the Seaway ports.

In the past two weeks reports have been received concerning the increased traffic on the Seaway which has occasionally resulted in delays due to congestion at the locks. It is obvious, however, that until a regular routine can become established, some difficulties will be experienced during the first few months of operating. The vexed question of pilotage also has to be settled and some time will elapse before the complicated system of tolls works smoothly. Efficient operation can only come with experience, but the ports along the Seaway are confident that this will be achieved. The Seaway Authority also, is optimistic that the completion of this international project will make the St. Lawrence River one of the world's most important arteries of ocean transport. This view is endorsed by the Canadian Tolls Committee who predict that the volume of cargoes handled should total 25 million tons in 1959 and 50 million tons by 1968.

Permanent International Association of Navigation Congresses

Mr. D. Luke Hopkins, Commissioner of the Maryland Port Authority has been appointed to the International Commission of the Permanent International Association of Navigation Congresses by the Department of State, and the United States Army.

The International Commission is the governing body of P.I.A.N.C. which now has a membership of 53 nations mutually interested in the progress of ocean and inland navigation by the free interchange of information on all aspects of maritime engineering and port operation.

The United States has 10 members on the International Commission which meets annually at its headquarters' offices in Brussels. The next meeting of the Commission will be held on June 2nd, 1959 and will consider plans and agenda for the twentieth meeting of the International Navigation Congress, scheduled to be held at the Port of Baltimore in 1961. This occasion will mark only the second time the Congress has met in the United States, the first having occurred in 1912 at Philadelphia.

The Congresses meet every four years in a member country selected by the International Commission. The last Congress was held in London in July 1957.

New Oil Refinery for Turkey

It was recently announced that a contract to build an oil refinery at Mersin has been awarded to the Foster Wheeler Corporation of New York. It is being built by 4 British and American Oil Companies at the request of the Turkish Government and is scheduled to be completed by the end of 1961. Preliminary site investigation work at the Mediterranean port is already in hand with construction planned to begin in about six months.

In addition to the processing units, the refinery will have two berths capable of handling simultaneously two tankers of up to 50,000 tons each. A smaller pier will accommodate a 20,000-ton vessel, and a barge wharf also will be built. Other facilities will include storage tanks, transfer lines, electrical generating and distribution systems, communication systems, office buildings, warehouses etc. The total cost of the project is expected to be about $50 million.

Materials Handling Lectures

Materials handling problems arise in every branch of manufacturing, transport and warehousing, and it is in the national interest that solutions to these problems should be found by a scientific and informed approach, leading to higher labour and capital productivity. To this end, the National Joint Committee on Materials Handling, a body on which are represented over 20 professional and kindred societies concerned with various aspects of the subject, feels that it may be able to assist secretaries of societies and other bodies drawing up their programmes for the 1959/60 sessions, by suggesting suitable subjects for lectures and possible lecturers. Further information may be obtained from the secretary, National Joint Committee on Materials Handling, 69 Cannon Street, London, E.C.4.

Export Guide to the Dominican Republic

Following the wide demand for a U.K. Exporter's Guide to the Dominican Republic, issued last year by the Dominican Republic Embassy in London, a revised edition has been prepared. The guide states that the Dominican Republic Government are anxious to encourage a greater volume of British exports, and useful advice is given on how this may be achieved. After giving some facts and figures and a general review of the Republic, the guide deals with trade figures, foreign trade, business procedure and practice, import regulations, and communications and ports. Copies of the guide may be obtained from the Dominican Republic Embassy, 37 Eaton Square, London, S.W.1.

Strengthening a Reinforced Concrete Wharf at Rochester

Integration of Repair Works with Original Structure

By C. G. CUMMING, M.I.C.E.

Synopsis

THE paper deals with strengthening works, for a coaling wharf at Lime Reach on the River Medway at Rochester, Kent, for Wm. Cory & Son, Limited. The strengthening was carried out so that the existing cranes could be replaced by a new and heavier type.

The new work was confined to the front of the wharf and included the driving of reinforced concrete piles. These piles were integrated with the original structures by piers cast in "Prepakt" concrete. Owing to the low resistance to driving of these piles it was found necessary to test load during the construction and to introduce a rigid waling beam between piers to assist in spreading loads.

The design and method of construction had to allow all phases of the work to be undertaken without interrupting the unloading of colliers or other normal coaling operations throughout the whole of the construction period. This made it necessary to avoid cutting out structural members in reconstructing the front of the wharf and for this reason mild steel welded girders were used for the front crane beam.

The work also included a new reinforced concrete cope, the removal and reinstatement of fenders and bollards, the construction of timber dolphins and dredging works with an investigation into the stability of slopes.

Introduction

The original wharf construction consists of Hennebiques patent Ferro-concrete built in 1907. In consequence, details of anchorage ends to reinforcing rods and lateral ties or stirrups differ from those used to-day and do not meet the requirements of present design codes. Details of reinforcement in the existing piles can be seen in Fig. 1.

The wharf is supported on piles at 10-ft. longitudinal centres braced to a point 20-ft. below deck level as shown in Fig. 2 and has a river frontage of 380-ft. Four standard gauge railway tracks are carried by the wharf as well as one crane track with rails situated before construction at 26-ft. centres. At the upstream end there is an approach of similar construction 130-ft. long at approximately right angles to the wharf with a length of frontage adjoining Common Creek which is used as an oil berth. In addition to crane and rail loadings the structure resists earth pressure from back filling which forms a working area behind the wharf.

Apart from repairs that have been necessary due to inadequate cover to the reinforcement in the beams, piles and bracings, the wharf is structurally sound after 50 years of use. The recraning programme with the subsequent substantial increase in crane wheel loads brought about the necessity to strengthen the front of the wharf. Strengthening to the rear crane beam was not necessary as this crane rail was positioned over a line of piles and a beam which was cast monolithicly with a curtain wall gave it increased strength. Furthermore, the loads on the rear crane rail are much less than on the front rail and are well within the capacity of the existing members.

The wharf handles an important coaling trade in this part of Kent and since 1911 some 18 million tons of coal have been discharged from colliers. During 1954, when the major part of the strengthening works were undertaken, the wharf handled more coal than in any previous year of its history. During that year the tonnage handled was 560,050 of which 311,230 tons were discharged to barge, 50,840 tons to road and the balance to screen and rail.

Steam cranes were used to discharge the coal until they were replaced in 1911 with five electric cranes each of 5-tons gross capacity. These cranes were among the first grabbing cranes of their kind designed to incorporate weighing machines and had an overall outreach over the wharf of 63-ft. 10-in. and a maximum rate of discharge of 150 tons per hour each.

Three new electric canes, each 10-tons gross load, with a maximum rate of discharge of over 300-tons per hour per crane have replaced the five former cranes. These cranes have an outreach of 67-ft. 6-in. over the wharf with a 90-ft. jib.

Previously, colliers of 2,500 deadweight tonnage berthed at this wharf and these had an overall length of approximately 268-ft. Recently the ships have increased in size to 4,600 deadweight tons with a length of 320-ft.

Design Considerations

An investigation into the depth of the existing structure revealed that the front piles and stringer beams carrying the front crane rail were already working to their maximum safe limits under loadings imposed by the 5-ton cranes whilst the main cross beams were overstressed. Still heavier wheel loads from the new cranes made it imperative that these members be strengthened or relieved in some way.

In the original design the front crane rail was positioned over a reinforced concrete crane beam supported at the ends by the main cross beams which in turn transferred the loads to the piles. Fig. 2 shows that this crane beam was positioned 1-ft. 8-in. shoreward of the centreline of the original piles. In this position overstressing of the main cross beam occurred; particularly when two 5-ton cranes were working side by side. This overstressing was eliminated by positioning the front crane rail over the line of existing piles. The shifting of the new crane rail 2-ft. riverwards had the added advantage of allowing the distance between crane rail centres to be increased from 26-ft. to 28-ft. so that the new cranes for this wharf would be interchangeable with cranes on other wharves or jetties operated by Wm. Cory & Son. Limited.

These works required the existing concrete cope beam and outer slab to be cut away as well as necessitating the removal and reinstatement of bollards and fendering to the front of the wharf. To carry the additional loads and to provide space for fixing bollards and working warps an additional row of piles 4-ft. from the existing ones was provided. This also gave sufficient clearance to avoid contact between ships and cranes. The cover to the reinforcement of existing piles and bracings was removed to a point 20-ft. below the deck along the front of the wharf and the new work was bonded to the old by casting reinforced "Prepakt" concrete piers above the new

piles and around the existing ones as shown in Figs. 3 and 4.

Lengths of the new piles were determined after a study of the existing borehole data and the original piling records. The rigid construction of the new piers enabled the loads to be shared between the old and the new piles and, as a result, piles 14-in. square were selected to carry the estimated working load of 40-ton. Piles driven along the front of the wharf in 1907 were generally 16-in. by 20-in. by 41-ft. long and it was estimated that they had carried loads up to 65-tons.

For the design of the piles along the front of the wharf two 10-ton cranes were considered working side by side with jibs parallel and centred over the left hand bogie of each crane. In order to transfer this wheel load to the piers and to avoid cutting away the load bearing parts of the original structure, 38 No. mild steel crane girders of welded construction were fabricated to span between the piers. A continuous beam was found to be impracticable owing to the small depth available at the supports. Also, due to variations in the spans between the piers of the original structure, crane beams of six different lengths had to be made up; the majority of these girders were 9-ft. 11¾-in. long as shown in Fig. 5. Clearance between the base of the crane rail and the top of the existing piles was extremely limited so that a thick web was necessary to take the heavy shear. Care was taken during fabrication to limit the errors due to distortion from the welding of the heavy sections. The error from transverse drop amounted to 1/16-in. and in the longitudinal direction to about ⅛-in. These inaccuracies did not affect the fixing of the crane rails which were bolted to the upper flange. The crane rails were of 112-lbs. per yard section, 40-ft. in length joined by electric welding after laying.

Construction Procedures

It was required to berth colliers and barges and to continue coaling operations at the wharf during the progress of the works. This made it necessary to limit the actual construction of the new works to half the length of the wharf at a time. Two temporary four pile dolphins were constructed, one 40-ft. upstream and the other 40-ft. downstream of the wharf to enable 2,500-ton colliers to be berthed using only half the length of the wharf for discharging. In order that the colliers could use the dolphins some 8,000 cu. yds. of dredging was undertaken, to give an overall minimum depth of 9-ft. below Port Datum (L.W.O.S.T.) and a minimum width of 70-ft. Fig. 6 shows the order of construction which was adopted and some of the temporary works which were necessary, so that unloading of colliers could proceed without interruption and at the same time ensuring

Fig. 1. Close up view of reinforcement of original columns.

a minimum of interference with the contractors.

The dredging works made it necessary to carry out an investigation into the stability of adjacent banks. The shear strength of the mud and clay overlying a gravel stratum was ascertained by vane tests. From an analysis of the critical slip circles on the existing slopes before dredging, it was found that the clay would have to be capable of withstanding shear stresses of the order of 275-lb. per sq. ft. and to be able to stand up to a slope of 1 : 5.5. However, practical considerations in carrying out the dredging works meant that slopes of 1 : 3 would be necessary requiring a shear strength of 377-lb. per sq. ft. The vane tests indicated that the strength of the soft alluvium overlying the sand and gravel increases from about 300-lb. per sq. ft. at level of O.D. Newlyn to about 600-lb. per sq. ft. at a point 20-ft. below datum. By calculation the banks at a slope of 1 : 3 were estimated to have a factor of safety of 1.2.

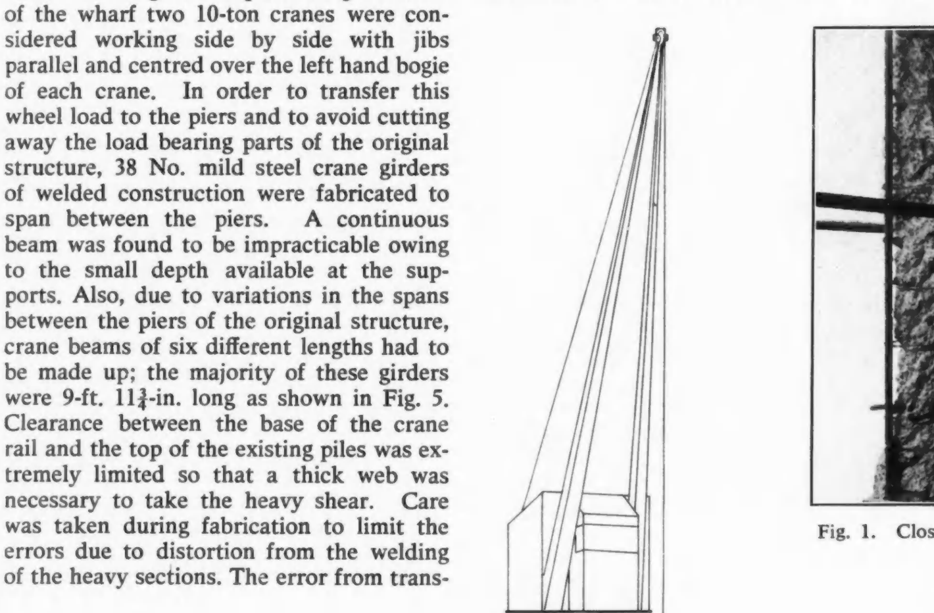


Fig. 2. Method of using existing wharf cranes to drive new piles.

Pile Driving

Thirty-nine reinforced concrete piles 14-in. square were driven, being of standard design, except for the heavy 60-lb. shoe en-

abling them to be pitched more accurately in the river currents. These piles were 45-ft. long, weighed approximately 4-tons and were well within the lifting capacity of the wharf cranes which were used for driving the piles in place of a pile frame so as to avoid interference with coaling operations which continued during the reconstruction.

A hanging leader was used and was held at the top by a temporary steel bracket welded to the crane crinoline and to the bogie as shown in Fig. 2. This was supported lower down during driving by a temporary timber bracket fixed to existing piles just above high water level. All piles were driven with a 4-ton B.S.P. single acting steam hammer with a follower to enable the piles to be driven at high tide.

The driving of the new piles was accomplished too easily and it was feared that they might not be capable of carrying the design loads. The set per blow when driving ceased varied from a maximum of 3-in. to a minimum of ½-in. With the 4-ton hammer dropping an average of 1.85-ft. the set per blow obtained was 1.26-in. To investigate the soil conditions further down two piles were lengthened, and re-driven after 5 days to a depth 20-ft. below the design level without achieving any appreciable improvement in driving resistance.

All piles were driven through varying strata of clay, silt and some coarse gravel into chalk in which flints and sand were present. Chalk is a material which can vary considerably both in composition and strength and when in the solid state is capable of developing fairly high resistances. However, under conditions where chalk has been softened by exposure to water or where its structure has been disturbed or broken down, it is convenient to compare it with a clay material. When piles are driven into this type of soil it is well known that they may exhibit the characteristics of easy driving such as were encountered on this site with a subsequent gain in driving resistance after a period of rest. An explanation of this behaviour may be that the chalk acts as a lubricant on the sides of the pile while it is "alive" during driving thereby reducing the effects of friction. Under these conditions the structure of the chalk is broken down and the end bearing is also reduced. After the pile has been static for some time the bond between the chalk and the pile may be re-established as well as the hardening of the material generally improving its end bearing resistance and hence the carrying capacity of the pile. Subsequently it was discovered that similar difficulties were experienced during the driving of the original piles giving rise to serious consideration of abandonment of the work. These measures might have been necessary had it not been for the improvement obtained when redriving some of these

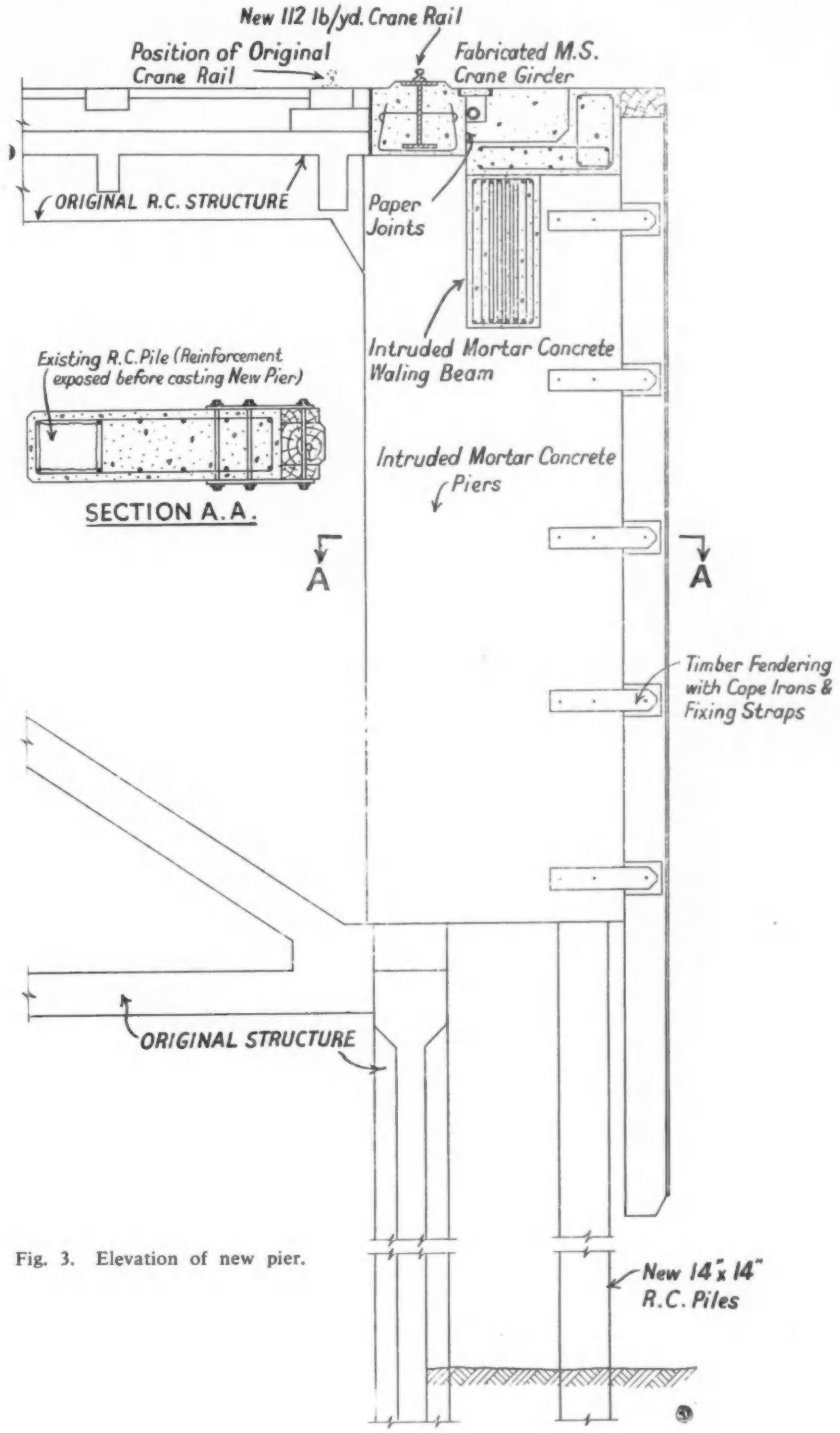


Fig. 3. Elevation of new pier.

piles after a period of rest showing an added resistance to penetration. Under these soil conditions dynamic pile formulae are not applicable and the bearing capacity of the piles must be determined by test loading. Accordingly, two piles at the downstream end of the wharf and one pile at the upstream end were driven to the design toe level of minus 43 O.D. Newlyn and test loaded one month after driving. These piles were loaded to 60-tons or 1½ times the maximum working load. Results of these tests are illustrated in the diagrams in Fig. 7. Test loading of the piles was carried out by jacking against a stabilised platform carrying kentledge greater than the total test load. The stabilised platform and the general method of test adopted is illustrated

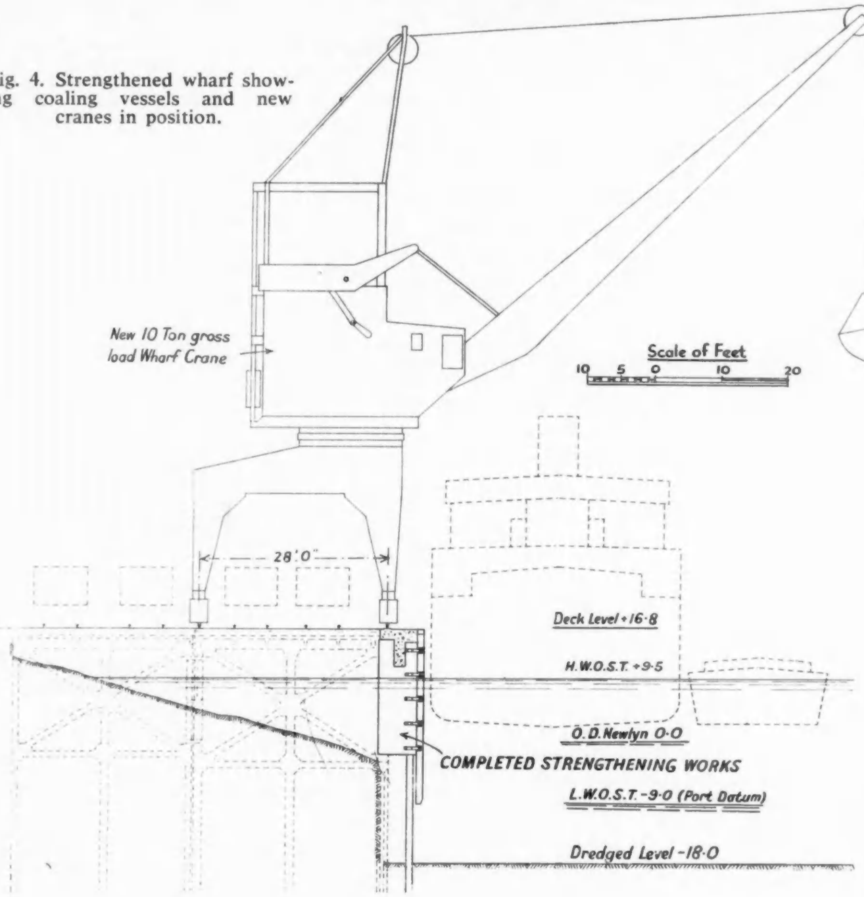


Fig. 4. Strengthened wharf showing coaling vessels and new cranes in position.

the volume of reinforcement and space between reinforcing bars was such that normal methods of placing concrete could not have been employed without risk of segregation and honeycombing. To construct the main waling beam, the shuttering to the underside of the beam was first erected to act as a working platform for the steel fixers. When the steel reinforcement cages, complete with stirrups, had been built in position, shuttering to the sides of the beams was completed and the coarse aggregate was placed in the forms from the sides, through panels left out for the purpose, and packed around the reinforcing bars. Coarse aggregate used for the waling beams consisted of 1½-in. maximum to ½-in. minimum rounded flints containing a small proportion of crushed "reject" material. In the piers a larger stone was used consisting of 3-in. maximum to 1½-in. minimum natural rounded flint rejects. After packing the stone in the forms, the voids averaged 45%.

In order to meet the specified minimum crushing strength of 3,000-lb./sq. in. at 28 days, the specialist sub-contractors recommended that the mortar to be made up in the following proportions: 112-lb. Portland cement; 56-lb. fly-ash; 250-lb. fine sand; 1.1-lb. (0.5 kg.) Intrusion Aid and 84-lb. total water. This mix yielded an average of 4.0 cu. ft. of mortar and had a water/cement and fly-ash ratio of 0.5. The fly-ash tends to contribute to long term strength gains and low volume changes. Intrusion Aid is a patent product delivered to the site in powder form. Its main functions are to produce a stable mortar; to lower the water requirement of the mix; to retain as much of the mixing water as possible in the mortar whilst it is setting and to reduce shrinkage; to cause a small expansion of the mortar during setting so as to compensate for any shrinkage; to delay the early setting of the mortar and help it to flow freely into the voids of the coarse aggregate; and to

in Fig. 8. A mild steel column braced to the wharf at two levels was fabricated in order to transmit the load from the kentledge platform at deck level to the pile head about 18-ft. below. Fig. 7 shows load settlement diagrams up to a maximum applied load of 60-tons. This is the maximum safe load that could be applied to the pile from considerations of the stresses due to the effective column length.

"Prepakt" Concrete

"Prepakt" concrete is made by packing the shuttering with coarse aggregate, after the reinforcement has been positioned, and pumping a mortar through a pipe into the bottom of the stone to fill the voids (Fig. 9). The mortar is prepared in a special mixer which agitates the solid particles in such a way that any air adhering to the surface is removed and the solids remain in suspension in the water approximating to a true colloidal condition. In the works described in this paper this concrete was used for underwater concreting between low and high tides as well as for concrete placed above high water.

The mortar can be pumped underwater into the bottom of the preplaced aggregate where it will displace the water without admixture and fill the interstices to form a concrete free from honeycombing. This concrete process was used to advantage in the piers, which extend approximately 10-ft. below high water level, where it allowed the placing of the aggregate and subsequent mortar injection to take place whatever the state of the tide. The reason for using this process in the main waling beam, which was entirely above high water level, was that

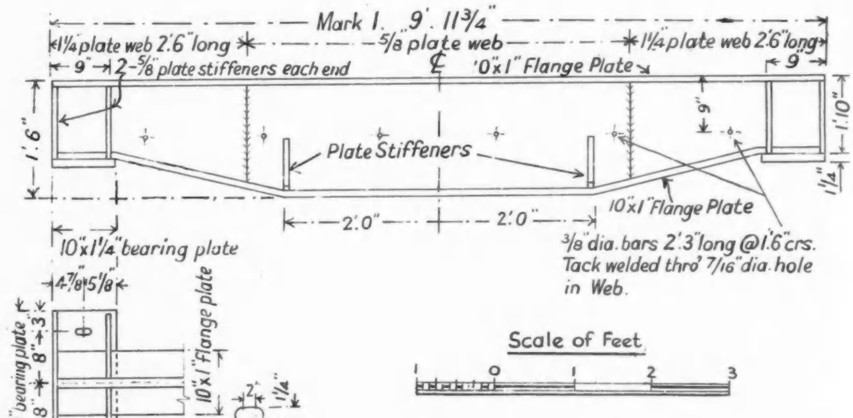


Fig. 5. Detail of M.S. crane girder.

simplify the mortar mixing operation and so enable slow speed mixing methods to be used.

Briefly, the mixing plant used on the works consisted of two fixed mixer tanks with stirring and special mixing apparatus which discharged into an agitator tank set at a lower level. The mortar was drawn off by a screw type pump capable of operating at 130 lb./sq. in. In practice the length of the mortar main varied between 100 and 250-ft. and the pressure required at the pump was 80 lb./sq. in. for 150-ft. pipe.

A flow cone shaped like a funnel was made up by the contractors and used on site to check the consistency of the mortar. It was found from tests that a mortar suitable for pumping had a consistency which resulted in a time of efflux between 16 and 23 seconds. The results of three flow cone tests on the mortar used averaged 23 seconds.

The recommended mix was expected to provide a concrete with crushing strengths of 1,500, 3,000 and 4,500-lb./sq. in. at 7, 28 and 90 days respectively. Whether or not these strengths were actually achieved in the piers and waling beam could not be verified satisfactorily as it was not practicable to remove cores from the work or to test by other means. A number of 6-in.

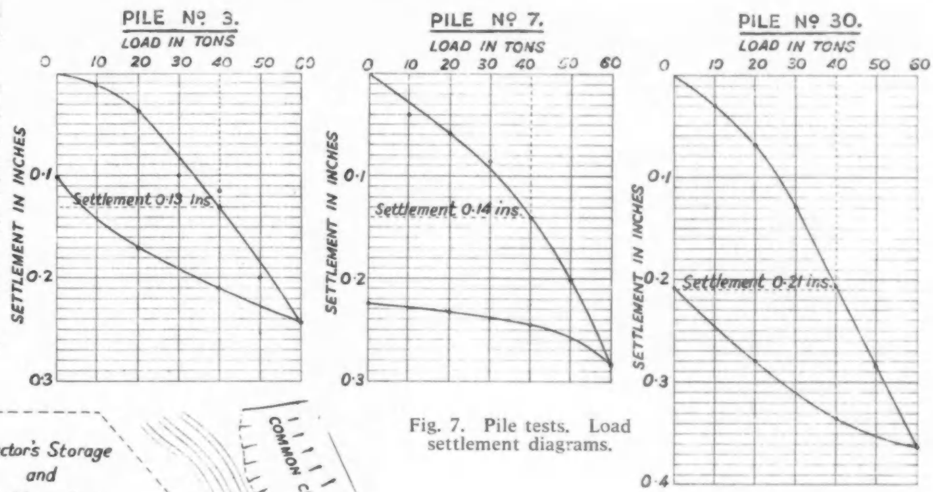


Fig. 7. Pile tests. Load settlement diagrams.

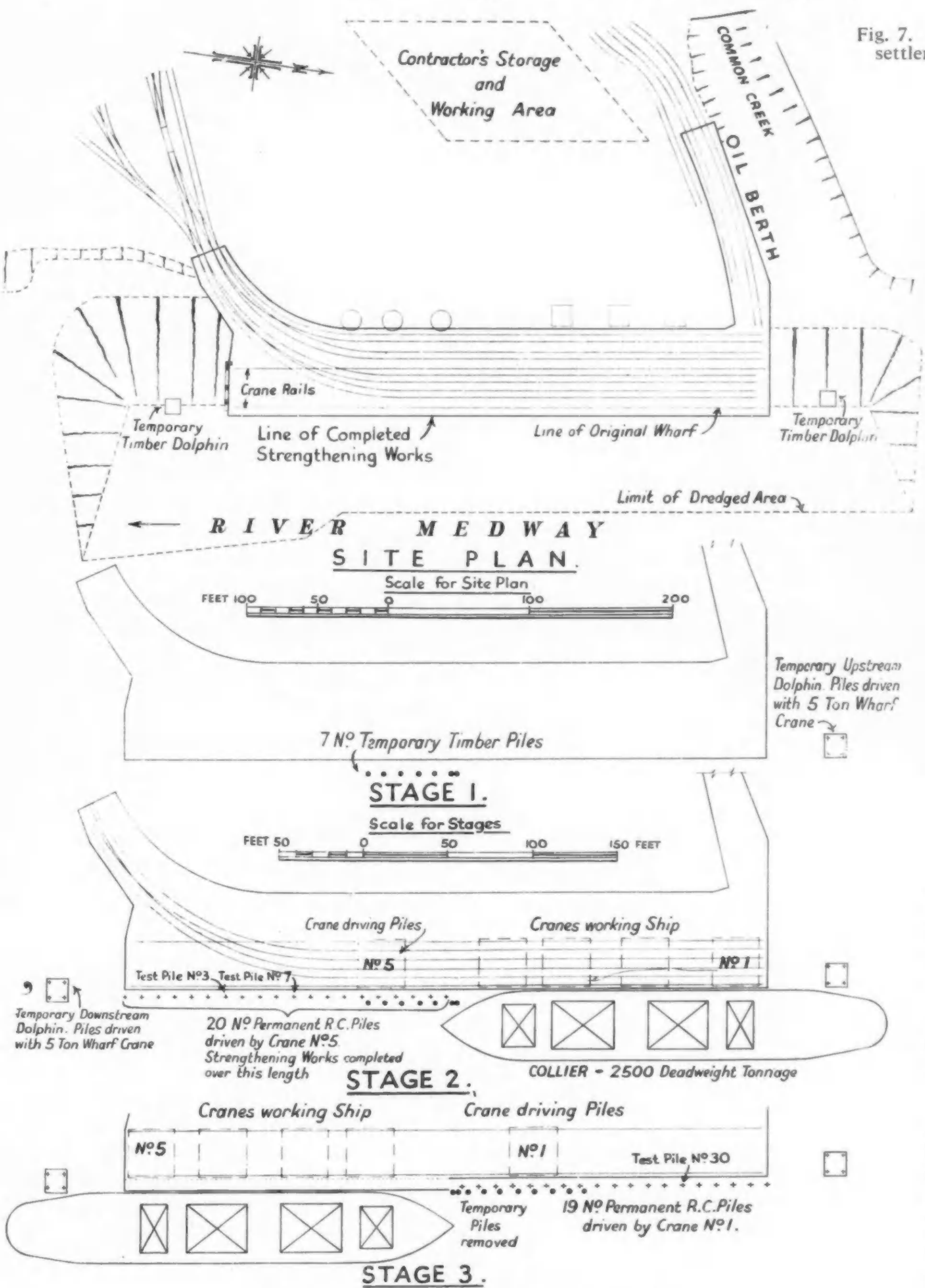


Fig. 6. Stages in construction of new work.

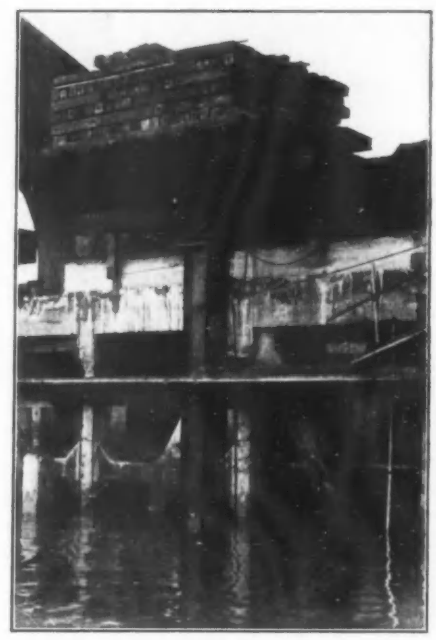


Fig. 8. Test loading pile No. 3. Pile extension, 100-ton jack and kentledge.

Fig. 9. The application of grout to Pier A.

Fig. 10. General view showing completed work.

cubes were made by packing 4 moulds with coarse aggregate, stacking them one above the other and injecting mortar into the base. The rate at which the mortar was injected into the moulds and the temperatures that the cubes were exposed to during curing did not simulate actual site conditions and as a result the cube strengths obtained probably represent the lowest interpretation of the strength of the concrete in the structure. Subsequent tests showed that to obtain a reasonably close approximation to the actual strength of concrete in the structure, cubes must be cured at 70°F.

Costs

Strengthening of the wharf, including test loading the three piles, was completed at a cost of £37,650 and the dredging referred to at an approximate cost of £11,500. These works were commenced in June, 1954, and completed in June, one year later.

In addition to the work discussed in this paper the 3 No. 30-ton hoppers which involved the initial placing of some fill material at a total cost of about £7,000 was carried out prior to commencing the strengthening works. The provision of the 3 No. 10-ton electric grabbing cranes is estimated to have cost £123,000. The general arrangement of the strengthening works and new cranes is shown in Fig. 4; the old cranes and the finished work by Fig. 10.

Acknowledgments

This paper is presented by kind permission of Messrs. Wm. Cory & Son, Limited, and the author wishes to thank Mr. J. B. Griffith, B.A., A.M.I.C.E., A.M.I.Mech.E., M.I.Mar.E., their Chief Engineer, for much valuable information.

Sir William Halcrow and Partners were consulting engineers for the works and the author is indebted to them for enabling him to write the paper.

The Demolition and Construction Co. Ltd. were the main contractors for the work and Messrs. Edmund Nuttall, Sons and Co. (London) Ltd. were specialist contractors for the "Prepakt" concrete.

REFERENCES

1 Strengthening Works to a Reinforced Concrete Waling Wharf. By C. G. Cumming, M.I.C.E. Published in abstract form in the Proc. Instn. Civ. Engrs. (May, 1959).
2 H. D. Morgan and C. K. Haswell. "The Driving and Testing of Piles." Proc. Instn. Civ. Engrs., Pt. 1, Vol. 2 (January, 1953).
3 "Investigation of the Suitability of Prepakt Concrete for Mass and Reinforced Concrete Structures." Corps of Engineers, U.S. Army, Technical Memorandum No. 6330.

Train and Car Ferries

By J. P. CAMPBELL, M.I.N.A.*

Train and Car Ferries comprise a wide diversity of craft found on seas, lakes, esturial waters and rivers all over the world, generally operating in places where the building of a bridge or the construction of a tunnel would be uneconomical or impracticable. They may be considered as links in a rail or road system and usually operate to a time schedule. Many maintain a continuous service and in consequence may make frequent crossings daily.

On most modern train ferries provision is invariably made for the transport of cars on another deck, whilst the train deck can also be used for this purpose when required. The loading of both decks can usually be carried out simultaneously.

*Abstracts from a Paper presented to the Institution of Naval Architects, London, March 1959.

TRAIN FERRIES

Operational Requirements

These types of ferry have to operate under exacting conditions, they are engaged in coastal waters on voyages of short duration and in all conditions of weather and tide. When their service is in the proximity of large ports they may have to cross busy shipping lines and at the approach to their terminals meet the dense traffic associated with these areas. It is therefore essential they have steering qualities of the highest order and that their propulsion machinery be capable of prompt response to all demands.

Rolling Stock

With the exception of Russia and the Iberian peninsula the

Continental railway gauge is the same as that in Britain, but owing to the freight trains on the Continent being much longer and in conseqence very much heavier than in this country stronger couplings would be required on the British rolling stock if used abroad.

The Continental railways consider the ferry services sufficiently important for them to supply all the necessary passenger coaches and wagons. Over 7,000 wagons have been specially constructed to cater for the goods carried, these comprise covered, open, refrigerator and insulated types, also motor-car wagons.

The wagons which cross into Spain have their axles changed at the frontier stations to cater for the different rail gauge.

Factors in Design

The only practical method of obtaining speedy loading and unloading, essential to limit the time spent at the terminals, is to employ the "Roll on, Roll off" principle.

In consequence train ferries carry their cargo only above the bulkhead deck, thus differing from normal freight carrying vessels in which all compartments below this deck with the exception of the machinery spaces can be utilized for the stowage of remunerative cargo.

It is thus desirable to keep the bulkhead deck as low as practicable, a requirement which is given additional importance by the need to avoid excessive superstructure, the importance of which will be realized when it is considered that the distance between bulkhead and upper decks must be at least 15-ft. 6-in. (4.72 m.) if passenger coaches are to be carried. A complication in this connection however, is that subdivision requirements also have an important influence on the height above water-line of the bulkhead deck. Even more headroom may be required if it is necessary to cater for any requirement peculiar to a particular service.

Careful attention has to be given to ensure that the propelling machinery combines efficiency with low overall height. Casings for uptakes must be kept to the minimum width, sited clear of rail tracks, and wherever practicable combined with those required for ventilation trunking and stairways. Provision may have to be made for platforms so that passengers can leave their coaches if desired.

The number of tracks will vary according to the size of the ferry; in general on the sea-going type 3 or 4 are fitted. Unless operating in open harbours, dimensions of the ferry may be governed by the limitations of the harbour and/or terminal, and the introduction of new, larger ferries may involve major alterations to the latter.

In the case of the Dover-Dunkerque ferries, to give sufficient working clearance between rail tracks and to permit essential pillaring it was found necessary to allow a pitch of 11-ft. 6-in. (3.51 m.) between centres of tracks; thus to fit four tracks a minimum breadth of 46-ft. (14.04 m.) was required, the breadth of passenger platforms and casings increased their moulded breadth to 60-ft. 8-in. (18.48 m.).

Although many sea-going train ferries, including those owned by British Railways, load and unload at the aft end only, the bow being of conventional form, some are arranged for carrying out these operations at either end. Examples of the latter are those operating where ice conditions make it essential for the vessel to proceed bow first into her terminal.

Where four tracks are fitted on a stern loading train ferry the two centre sets are usually parallel and continued as far forward as practicable. The wing tracks are carried forward until, following the line of the deck, they approach too close to the centre tracks to be of value. The deck space forward of these can be utilized for the fitting of a capstan to assist in hauling wagons along the rails, or for storage space. At the aft end the outboard rails merge into the centre tracks, care being taken that the minimum safe track radius is maintained; a system of points is fitted so that coaches and wagons can be switched to the track on which it is desired to carry them. A string of wagons well in excess of 100 tons in weight is often directed in one shunt along a track, so provision must be made to quickly counteract heeling, also to keep the ferry on a reasonably even keel. Wing and fore and aft ballast tanks are therefore necessary, together with high capacity pumps capable of rapidly transferring water ballast.

There should be no sheer on vehicle deck and camber should be reduced as far as practicable.

To enable ferries to withstand the knocks inseparable from frequent manœuvring in confined harbours under all weather conditions without the aid of tugs, it is essential to provide permanent fendering to the hull, preferably in line with a continuous deck.

Securing arrangements have to be provided for each individual coach or wagon, and these have to be particularly efficient in view of the heavy weights involved. Buffer stops are fitted at the forward end of each track and the wagons are pushed up hard, buffer to buffer; weight is taken off the springs by means of screw jacks and finally the vehicles are secured to the deck by chains and stretching screws.

The "Twickenham Ferry" in dock at Dover.

Terminal Facilities

If there is a small tidal rise and fall, as in the Baltic, 4-ft. (1.22 m.), loading can be carried out in an open harbour, all that is required is a bridge fitted with the necessary rail tracks, hinged at the shore end and capable of being raised and lowered to connect to the ship.

The length of the "Link Span" as the connecting bridge is termed should be such that excessive gradients are avoided, in practice it has been found desirable to limit the latter to 1 in 20.

Where there is a large tidal variation and the operation of a very lengthy link span may be considered impracticable the loading operation must be restricted to certain tide limits. If the volume of traffic to be handled, or the time schedule of the service does not permit this restriction of working time, it will be necessary to arrange the terminal in a tidal basin in which depth of water can be kept within limits by means of lock gates, or, as was necessary at Dover, where there is a variation in tide level of 28-ft. (8.53 m.), to construct an enclosed dock, somewhat similar to a graving dock. At this terminal the ferry enters the dock at any state of tide, the gates are closed and water pumped in or out, until the train deck is level with the shore track. The

link span, 70-ft. (21.33 m.) long, which is articulated to accommodate a 5 deg. list, is then lowered into position and secured. The securing device is interconnected to the main line signalling system, thus ensuring no movement of traffic until the vessel is in the correct position and the tracks safely connected.

CAR FERRIES

The design of car ferries follows closely that of train ferries in so far as vehicles are stowed above the bulkhead deck. The sea-going type is usually end-loading whilst those operating in esturial waters, lakes or rivers can be either side and/or end loading, many carrying the vehicles on the open deck.

As on train ferries it is essential that substantial fendering be fitted to the hull.

Sea-going Car Ferries Factors in Design

In the vehicle decks the casings should occupy as little deck space as possible and should be sited preferably on the longitudinal centre line, with clear athwartship deck space arranged forward, aft, and amidships to expedite stowage and turning of vehicles, for which purposes turntables may also be necessary.

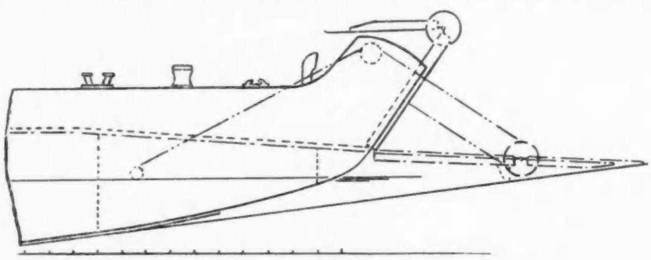


Fig. 1. Double-ended road vehicle ferry showing hinged loading ramp for use as a slipway.

The vehicle deck can have normal sheer but camber should be a minimum. Wing tanks are not a necessity as a slight list whilst loading can be corrected by a selective stowage.

Some check to wheels to prevent the vehicle coming into contact with casings, ship side frames, etc., must be provided. It may be arranged as a raised platform about 6-in. (0.15 m.) high in way of all such structures, in which case if fitted with a chequered plate top, it can serve as a walkway for passengers and fire patrol. With the standing flange perforated it may also be utilized as a distribution trunk in the mechanical ventilation system.

The ventilation of the vehicle deck is of major importance, particularly when unloading, as at this time many drivers may be starting their engines simultaneously, and there is danger of an excessive concentration of exhaust fumes. Ample capacity supply and exhaust fans connected to openings suitably sited throughout the car spaces must be fitted, the necessary trunking being arranged where practicable inside the lines of frames and beams.

Cars are transported with fuel in tanks and stringent precautions against the possibility of fire in the vehicle deck must be taken. In addition to the customary sprinkler system and hand extinguishers, foam making machines are installed and sand boxes are also provided.

The car deck has to be divided into the statutory main vertical zones and for this purpose fireproof curtains or shutters are fitted in many ferries, but modern practice is to fit water spray curtains with a supply independent of the sprinkler system and fire main. On passage the car deck is out of bounds to all but the fire patrol, the fireproof access doors being kept closed.

The securing of cars differs from that of rail stock because of their wider variation in shape and size. It can be accomplished by fitting numerous lashing pits or eye plates throughout the deck; an alternative method frequently adopted is to secure parallel lines of taut wire rope to the deck, the cars being secured to the wires by rope lashings.

Car ferries as their name implies are designed primarily to carry private cars, but it is prudent to cater for the carriage of a number of larger and heavier vehicles by strengthening a portion of the deck in way of a loading position and providing increased deck height.

Terminal Facilities

Cars are driven on and off the ferry in a regulated stream over a connecting bridge, but as larger working gradients (1 in 8) than in the case of a train ferry link span can be accepted and as the free end of the bridge need not be rigidly secured to the deck, the terminal can usually be arranged in an open harbour (see Fig. 1).

Double Ended Car Ferries Factors in Design

Ferries in this category are symmetrical about their athwartship centre line, they have similar loading arrangements at each end, can maintain the same speed in each direction, have duplicate sets of statutory navigation lights for use at night to show the direction in which they are proceeding and their rudders are duplicated.

In the smaller ferries one wheelhouse may suffice if high enough to give a clear view over both ends, but in larger ferries it may be necessary to fit one forward and aft, each with the necessary engine and steering controls and navigational equipment.

On these ferries vehicles usually drive on at one end and off at the other and turning space is not required.

Casings should be kept as narrow as possible. They may be sited on centre line clear of ends, at sides, or alternatively at one side only as on aircraft carriers, to permit the stowage of the maximum number of vehicles in straight lines.

Where the end bulwarks are designed to hinge downwards to act as loading prows it is necessary to have straight deck ends for the width of the prow opening.

When loading is from a slipway, the ferry should have a rise of keel at the ends to permit berthing as far up the slipway as practicable (see Fig. 1), rubbing strips should be fitted where chafing by bottom contact is liable to occur.

Passenger accommodation may be necessary and this will vary in amenities and extent according to the requirements of the service.

Statutory life saving, fire prevention and extinguishing equipment must be provided and it has become the practice to fit all modern navigational aids to these ferries.

Side Loading Car Ferries

The design of these follows closely that of the orthodox passenger ferry except that clear deck space is arranged for the stowage of cars; the extent of this is governed by the number to be carried. To facilitate stowage a turntable may be found necessary. Loading will be through ship side doors.

Terminal Facilities

Where there is no tidal variation and quay level approximates to that of the vehicle deck, loading is a straightforward operation. In tidal waters where a pontoon berth is not available the alternatives are to provide a hinged shore ramp or to use a slipway.

Loading Doors

Various types of doors are used on sea-going ferries to close the openings through which vehicles are loaded. In the case of a

train ferry where a link span carrying twin rail tracks has to be accommodated the minimum size of the opening will be 23-ft. (7.01 m.) wide by 15-ft. (4.57 m.) high.

In the case of an end loading car ferry, the dimensions of the loading bridge and the amount of surge, etc. likely to occur at the terminal will influence the width of the opening, which must also be high enough to permit the passage of any vehicle which can be carried on the ferry; an average size opening will be 18-ft. (5.49 m.) wide by 13-ft. (3.96 m.) high.

Following the loss of the "Princess Victoria" in 1953 much attention has been given to the design of loading doors and on many existing ferries they have been strengthened. The essential requirements are that the door or doors should be equivalent in strength to unbroken shell plating and be watertight when closed. On modern ferries most doors are of steel construction, suitably stiffened and power operated.

The Baltic ferries generally are fitted with a "Bascule" type door comprising a bow visor above the vehicle deck incorporating the stem, the adjacent shell plating and a portion of the foc'sle head deck. On some of these ferries, this portion of the structure is of aluminium alloy but on later vessels steel construction is employed. Other types of door include sliding, as on the Italian State ferry "Carraddi," side hinging as on the British Railways ferry "Dinard," hinging down flat type as on the Atlantic Steam Navigation Company's "Bardic Ferry" (in this case vehicles run over the opened door when loading), hinging up flat type as on the British Railways ferry "Maid of Kent" and folding as on the French Railways ferry "Compiègne." There are also roller blind and portcullis type doors. Securing arrangements, locking and safety devices will vary greatly according to type of door.

Bow Rudders

Many ferries which load over the stern, approach their loading terminals by a channel too narrow to permit swinging at the berth. In this case they swing at the entrance to the channel, or if space is limted here, at the harbour entrance, and proceed to their berth stern first. Rapid manœuvring and gaining of astern way are essential in these circumstances, and a high astern speed, possibly as high as harbour regulations permit, becomes desirable. The use of the stern rudder and variation in the power transmitted by twin screws, if fitted, give some control over steering when proceeding astern, but to give best results it is advisable to fit a bow rudder as near the stem as practicable. This is usually shaped to follow the hull form, and must be fitted with a locking device to secure it in mid position when proceeding ahead at speed. Where the hull form permits, a balanced bow rudder may be fitted as on some Baltic ferries, where this is incorporated in an ice cutting frame. In ferries with a high astern speed a locking device is sometimes fitted to the stern rudder to secure this in mid position when the vessel is proceeding astern.

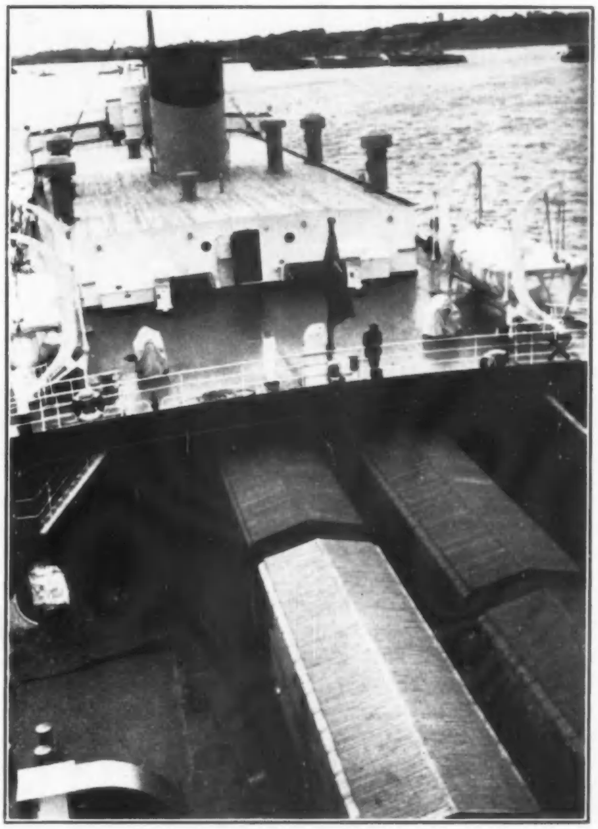
Lateral Thrust Units

If for any reason there are dimensional limitations to the size of the ferry which can be accommodated at the terminals the payload can only be increased by fitting additional vehicle-carrying decks. It is desirable to keep the height of superstructure, particularly at foreward end, as low as possible, so that the vessel will respond readily to the swinging and other manœuvres which can be effected by varying the direction of rotation of twin propellers.

Where vessels with high superstructures are required to operate a regular service under all weather conditions, some method of assisting swinging has been found desirable, if use is not to be made of tugs, and it has now become the practice to fit a bow thrust unit controllable from the bridge. Use of a cycloidal, controllable pitch or reversible propeller can be made to impart a lateral thrust to the head of the vessel if sited in an athwartship tunnel at the forward end.

The shape of the aperture will depend on the type of propeller fitted. If cycloidal, the cross-section will be rectangular the blades only being inside the tunnel. If screw type, the aperture will be circular. The internal supports required for the latter will however cause some obstruction to free flow of water and may set up vibration.

To reduce the possibility of damage to the propeller, guards should be fitted in way of the inlets. These should be sited longitudinally, streamlined, and at sufficient pitch to ensure that the water supply to propeller is not restricted.



Wagons on m.v. "Norfolk Ferry."

Unless a closing device following the contour of hull form can be fitted to the aperture, an increase in hull resistance when proceeding ahead must be accepted. From tank tests it has been estimated that with a carefully designed aperture this can be reduced to approximately 3 per cent.

Conclusion

This paper would not be complete without reference to some of the advantages and disadvantages from a commercial standpoint of train and car ferry services; also to future trends.

The maximum freight load of a train or car ferry will represent only some 25 per cent of the bale capacity of the deck on which it is carried. A considerable sacrifice in carrying capacity has thus to be accepted in the operation of roll-on, roll-off traffic; this, however, is offset by elimination of charges for shed space,

cranage, and handling at ports; protective packaging can be reduced, maybe even dispensed with, time in transit is reduced, goods are not liable to damage through careless handling or by being left unattended on open quays, and perishable goods can be maintained in condition by carrying them in specially designed or adapted wagons. Even with all these advantages, however, if the service is to be operated economically the ferries must maintain the most frequent service possible, a point of paramount importance when considering the design of these vessels. The frequency of service is of particular importance in the case of car ferry services where wide seasonal fluctuations of traffic occur and it would be uneconomical to operate additional vessels solely to cater for peak periods.

Certain passenger ferry services have a regular clientele as, for instance, the Dover/Dunkerque night train ferry, where a passenger can leave London at 9.0 p.m., have an uninterrupted night's sleep, arrive in Paris or Brussels at breakfast time, transact a full day's business, and return to London the next night under the same restful conditions.

Train and car ferry traffic is continually increasing; new services are being brought into operation and ferries of greater carrying capacity and operational range are being built. The "Princess of Tasmania," 370-ft. (112.77 m.), with accommodation for 120 cars and 334 passengers, designed to maintain a 14-hour overnight service between Melbourne and Tasmanian ports, which was launched in Newcastle, New South Wales, last December, is a very recent example.

Finally, the design of train and car ferries will require ever-increasing thought and attention, in view of the importance of maintaining effective links between the greatly improved rail and road communication systems being provided all over the world.

East African Harbours

Excerpts from Annual Report for 1958

The annual report for 1958 recently published by the East African Railways and Harbour Administration states that the gross revenue from all services of the East African Harbours declined by 2.3 per cent from £4,615,000 in 1957 to £4,509,000 in 1958. Although there was a record tonnage of general exports, the volume of general imports dropped sharply and the total tonnage of cargo handled decreased from 4,456,000 to 4,350,000 harbour tons. Ordinary working expenditure was £3,421,000. Including renewals, operating costs were £3,728,000, a reduction of £91,000 on the previous year's expenditure and this nearly offset the reduction in revenue.

In general, facilities for handling cargo were adequate for the tonnages passing through the ports and congestion only occurred at times of strikes which affected working on one or two occasions. There were, however, fairly wide seasonal variations in the volume of traffic, particularly at Mombasa. Such fluctuations in traffic, resulted in considerable unused port capacity for parts of the year, and had an inevitable effect on costs.

Mombasa

The general cargo exports of 943,000 tons, from this important deep water harbour reached the highest total so far achieved. The figure shows an increase of 120,000 tons over that for 1957. General cargo imports were at a low level of 888,000 tons, 153,000 less than in 1957. Coal imports increased by 7,000 tons to 37,000 tons and services cargo by 17,000 tons 26,000 tons.

The number of ships (excluding dhows) entering the port during the year was 1,155, or 124 less than the previous year. The average tonnage of general cargo, imports and exports, handled per ship working day improved to 558 tons. In September, berthside tallies, except for certain special items of cargo, were discontinued for imports and a system of tallying in stack was experimentally adopted.

The improvements in operating and control methods introduced in 1957 were extended and further economies effected in internal port movement, particularly in use of Scammell lorries, and in the operation of the lighter fleet. From August onwards the lighterage wharves worked on a one shift per day basis supplemented by overtime or second shift working as required. No. 10 berth was brought into use as an open berth at the end of May and, with the completion of the 120,000 sq. ft. transit shed and the stacking ground, was in full use by the end of the year. This additional capacity allowed servicing such as dredging, renewing of bunker oil pipelines and resurfacing to be carried out on the other berths. On the mainland, at Kipevu, reclamation work and the building of the four quay walls of Berths 11 and 14 showed good progress. Piling was nearly completed at the end of the year and construction of reinforced concrete beams and decking was well in hand. Funds were approved to provide Berths 11 and 12 with road and rail tracks, transit sheds and stacking grounds. The service at Berth No. 9 was interrupted for some time while engineering works proceeded.

Facilities for the handling of passengers were temporarily improved by the conversion of one of the four back-of-the-port transit sheds to a passenger and baggage hall.

Dar es Salaam

General cargo exports at the lighterage port of Dar es Salaam showed an increase of 8 per cent from 326,000 tons in 1957 to 352,000 tons, the increase was offset by a 11 per cent reduction in general cargo imports from 350,000 to 316,000 tons. A new bulk oil jetty came into operation in April and maintained by the 21 per cent increase in imports of bulk oil.

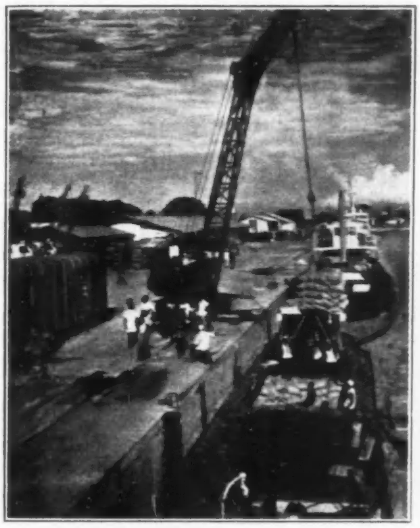
The methods of control of internal port movement and lighter fleet operation which had already been introduced successfully at Mombasa were extended to Dar es Salaam. Innovations in handling cargo included palletization of cement imports, lead

Bulk oil tanker m.v. "Nyangumi" on Lake Victoria.

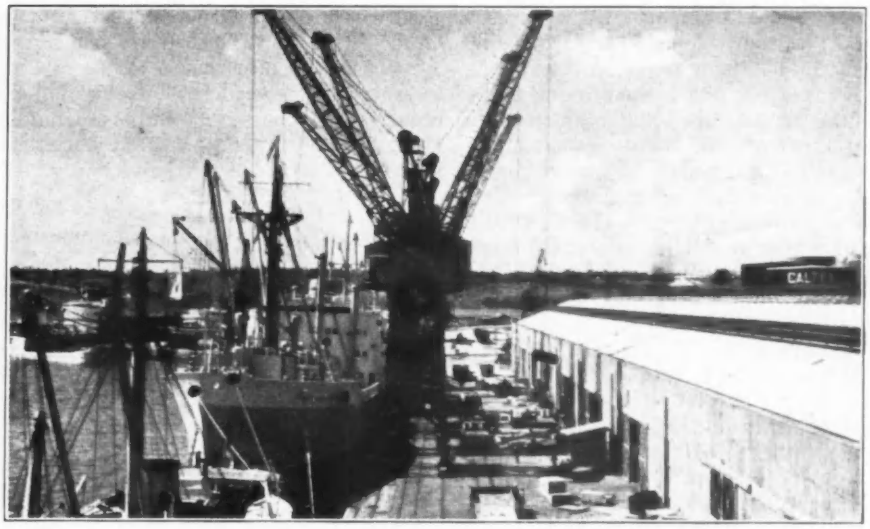
ore exports and coffee exports from the Belgium territories. Future developments entail the construction of an additional 110,000 sq. ft. transit shed at the Princess Margaret Quay behind the transit shed No. 2/3.

Tanga

At Tanga imports of general cargo declined from 70,000 to 53,000 tons, while general cargo export increased from 193,000 to 208,000 tons. Transhipment traffic increased very slightly to 2,600 tons. The development of the bulk oil trade in shallow draft coastal tankers operating from Mombasa, introduced in 1957 was substantial. The port worked well within its capacity throughout the year and there were no delays due to a shortage of lighters. The average tonnage, imports, and exports, handled per ship working day, was 509 tons.



Port of Kigoma, Lake Tanganyika.



No. 10 Berth, Kilidini, Mombasa.

Southern Province

At **Mtwara** there was a general decline in trade. General cargo imports dropped from 19,000 to 16,000 tons, exports from 67,000 to 56,000 tons, and transhipment cargo from 8,000 to 3,000 tons. A total of 96 ocean-going vessels called as compared with 81 in 1957, for smaller average tonnages, and the turn-round of ships was satisfactory except during labour disturbances during the first three months of the year.

Traffic at **Lindi** varied very little from the previous year. The lighter fleet which had been reduced from 17 to 13 in 1957 was increased to 15 craft to give more flexibility of working, and an additional crane was placed on the pier head with a resultant improvement in the turnround of ships. Repairs and renovations were carried out to jetties and buildings in the port in the latter part of the year.

Inland Waterways

Public goods traffic on the Lake services increased by 8 per cent from 330,000 tons to 357,000 tons. Traffic on Lake Kioga showed an increase from 62,000 tons to 71,000 tons, whilst traffic on Lake Albert and the West Nile, where the cotton crop was again below average, remained virtually unchanged at 32,000 tons. Traffic on Lake Tanganyika amounted to 7,000 tons, a slight improvement on 1957. On Lake Victoria the traffic pattern was very similar to that of 1957, tonnages being comparatively low in the early part of the year, but increasing considerably in the later months. In all, a total of 246,000 tons was carried on the Lake, a record figure and 17,000 tons higher than in 1957. The tonnage handled at Mwanza Port was again a record, being 109,000 tons compared with 99,000 in 1957.

Two new 200-ton capacity lighters, transferred from the port department, were put into service on Lake Victoria and helped in clearing the increased traffic. The self-propelled bulk oil tanker, m.v. "Nyangumi," was also put into service on Lake Victoria and a bulk oil lighter of 150-ton capacity was built at Kigoma for the transport of oils on Lake Tanganyika to Mpulungu, where the Northern Rhodesia Government has provided shore facilities for this new traffic.

The number of passengers carried on the inland waterways services fell from 713,000 in 1957 to 702,000 in 1958.

Port Labour

Unsettled labour conditions persisted at most East African ports during 1958. For the first half of the year Mombasa was free of trouble after a tribunal award had settled the November 1957 strike, but further strikes occurred in June and October. The first lasted four days, but the second was more serious, lasting from 30th September until 8th October. The reasons for the stoppages proved to be frivolous complaints against the Landing and Shipping Company and were in no way connected with pay or conditions. Both delays necessitated the calling in of outside labour to work the port.

At Dar es Salaam, stoppages of work occurred from 26tth August until 2nd September and again in November, the underlying cause being the unwillingness of casual labour to have their attendances recorded, despite the acceptance by the Joint Industrial Council in February of the need to attend for call-on and to prove attendance. Difficulty in applying the labour rules prevented a rational solution to the problem, which was aggravated by the swollen register of casual labour. However the Landing and Shipping Company introduced a measure of stability by increasing the employment of labourers on monthly terms.

There was a steady improvement in labour relations at Tanga during the year, which resulted from the firmer action taken by the employers against unofficial strikers, and from the election of a new executive of the Dock Workers' Union who have maintained discipline in the union. A third factor was the introduction of attendance money payments to casual labour.

Oil-Hydraulic Operation of Cranes

Recent Developments in Belgium*

By H. CLERCKX and J. DERIES

There is, of course, nothing fundamentally new in the application of hydraulic power transmission to cranes. Early hydraulic cranes were operated by water under a pressure of some 50 kg./cm². More recently, oil-hydraulic operation was introduced, but was at first limited to one specific motion (usually the luffing motion). As in the older hydraulic cranes, speed control was generally effected by means of manipulating valves and similar devices. The cranes described in the present article have been developed in Belgium since 1954 and are, except for the main travelling motion, wholly hydraulic in operation. Swashplate-type variable-delivery pumps, together with their appropriate motors, are used for effecting all the handling motions. The authors claim that, in respect of quality of performance, these modern oil-hydraulic cranes are rivalled only by the most expensive types of electrically operated crane. It should be pointed out, however, that the variable-delivery hydraulic pumps and motors embodied in the cranes are not in themselves a new invention.

In machinery operated by hydraulic power the moving part or mechanism is actuated by a volumetric "receptor," i.e. a device whose displacement (which may be a rotary or a translatory motion) is proportional to the volume of hydraulic medium that is forced into it. The speed of the part or mechanism in question will therefore be proportional to the delivery rate of the medium, while the force or torque developed by it will be proportional to the pressure employed. In the present treatment of the subject, the envisaged hydraulic medium is oil.

In the case of hydraulic cranes an essential requirement is to be able to control the speed of a motion (e.g. luffing, slewing, hoisting) within as wide as possible a range. Speed control can be achieved by varying the rate of delivery of oil to the receptor, and this can be done in either of two ways, viz. by employing a constant-delivery pump in conjunction with a manipulating valve, or, alternatively, by using a suitable variable-delivery pump.

The first method has the disadvantage of poor efficiency, inasmuch as speed control entails considerable power losses. In addition, this system does not ensure definite and reproducible speed control, the speed being affected by the ambient temperature (on which the viscosity of the oil is in a great measure dependent) and by the magnitude of the load. The latter disadvantage is particularly objectionable in the case of a crane, where considerable load variations occur in the course of normal operation. Hence the only practicable solution for such purposes is provided by the second of the above-mentioned alternatives, viz. the use of pumps whose delivery rate can be varied at will.

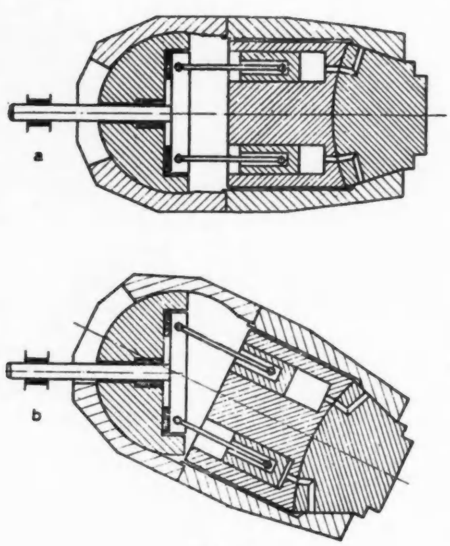


Fig. 1.

The pumps of this category which are suitable for crane operation are of the plunger type. In general, the plungers may be arranged either axially or radially. In Belgium, axial-plunger pumps have hitherto exclusively been employed for hydraulic crane machinery. A pump of this kind (Fig. 1) is provided with a series of plungers mounted parallel to the axis of rotation. The end of each plunger rod is fitted with a ball-and-socket joint which is attached to a rotating disc (called a "swashplate") fixed to the end of the driving shaft of the pump. The plungers can move to and fro in cylinders bored in a component which participates in the rotary motion imparted to the pump by the driving shaft. During the rotation of this component the ports in the cylinder heads alternately communicate with two fixed openings in the pump casing. These openings are connected to the suction pipe and the delivery pipe respectively. The pump casing can be tilted by pivoting it about a fixed axis perpendicular to the driving shaft. If the angle of tilt is zero (Fig. 1a), there is no relative movement of the plungers in their cylinders, and no oil is pumped. If, however, the pump is tilted (Fig. 1b), then the plungers will move to and fro, and the pump will deliver oil at a certain rate of flow. The delivery rate increases with the angle of tilt applied to the pump, and the direction of flow will depend on whether the pump is tilted one way or the other. Pumps of this kind have normal operating pressures of up to 150 kg./cm.² and can cope with peak values of as high as 250 kg./cm².

The receptor is either some kind of a jack or it is a hydraulic motor, according as the required motion is a translatory or a rotary one. The motor is similar in construction to the pump described above, except that the angle of tilt is kept constant at a value corresponding approximately to the maximum angle of tilt applied to the corresponding pump. When oil is forced into the cylinders of the motor, a rotary motion is produced.

Thus, with the above arrangement—viz. a variable-delivery pump and a hydraulic motor based on the same principle of operation—it is possible, by appropriately varying the angle of tilt of the pump, to adjust the speed of the motor to any desired value, between zero and maximum, and furthermore to change the direction of rotation at will. In this way smooth, instantaneous and accurately variable speed control, down to very low speeds, is obtained. These features represent a considerable advantage over electric systems of operation, in which comparable precision and smoothness of control can be achieved only by means of complicated auxiliary equipment (e.g. Ward-Leonard control with amplidyne excitation).

Tilting the pump in accordance with the principle described above cannot be affected manually, the force required being too large. For this reason a hydraulic servo-mechanism is used for the purpose. This device consists essentially of a jack which is actuated by oil under pressure supplied by an auxiliary pump. The crane driver manipulates a control lever which displaces the ram of the jack, and this in turn varies the angle of tilt of the driving pump. The rate of displacement of the ram and of the tilting of the pump—and, consequently, the acceleration applied to the crane mechanism—is governed by the rate of delivery of oil by the auxiliary pump to the jack. By suitably limiting this last-mentioned rate (which is a fairly simple matter), it is thus possible to limit the acceleration to a predetermined value, which is independent of the manner in which the control lever is manipulated. The crane and its equipment are thereby pro-

*Summary of Paper presented at the Third International Harbour Congress which was held in Antwerp in June 1958 under the auspices of the Royal Flemish Institution of Engineers.

tected from overloading due to impact effects resulting from possible rough handling of the controls.

A further advantage of this type of hydraulic drive is that the torque or the force developed by the mechanism can be limited to a safe predetermined value by the provision of bypass valves which, in the event of limiting pressure being exceeded, " short-circuit " the receptor and thus relieve the hydraulic pressure supplied to it. In this way a simple and effective safeguard against overloading is obtained.

A hydraulic power transmission system embodying pumps of the envisaged type possesses a high efficiency, inasmuch as the delivery rate and the pressure of oil are automatically adapted to the speed, or to the torque or force developed, without involving any losses in stop valves or suchlike devices. In addition, the mechanical losses in the pumps and motors are low.

The pumps are driven by electric motors which are kept running continuously; the power they have to develop will undergo only a gradual increase when the corresponding hydraulically effected motion are initiated. Consequently, starting impulses and surges, such as occur with electric crane equipment of the conventional type, are entirely eliminated. It is, moreover, possible to use three-phase A.C., which is more economical than D.C., and yet to obtain flexibility and smoothness of operation superior to those obtainable with D.C.-driven cranes.

Hydraulic operation offers yet another advantage in that certain motions can be linked to certain other motions or be made dependent on external factors. Thus, it is possible, by the provision of certain auxiliary equipment, to cause the hoisting speed to be automatically governed by the weight of the load that is being handled, or to make the angular slewing velocity of the jib dependent on the outreach.

The principal advantages offered by hydraulic operation of the type under consideration may be summarised as follows: (1) smooth speed control from zero to working speed; (2) the possibility of achieving very low speeds permitting accurately controlled motions; (3) automatic limitation of the acceleration, which is made independent of the mode of manipulation of the controls; (4) automatic limitation of the torque or force developed by the mechanism; (5) high efficiency at all speeds; (6) elimination of surge effects in the electricity supply mains; (7) the possibility of interlinking certain motions and of achieving automation of certain functions.

Against these advantages must be set the disadvantage that the requisite hydraulic must be constructed to a high standard of precision.

In the present treatment of the subject it has so far been assumed by implication that there are no losses due to internal leakages of oil within the hydraulic system. Actually, however, a certain amount of bypass leakage occurs, both in the pump and in the motor, between the intake and delivery openings in the casing. The rate of leakage is approximately proportional to the difference in pressure between the two openings concerned, and this difference is proportional to the torque developed. Hence it can be inferred that, for a given angle of tilt of the pump, the speed of the driven mechanism is not constant, but will diminish linearly with increasing load. On increasing the load from zero to its full value, the corresponding reduction in speed due to the above effect amounts to about 4 or 5 per cent. of the maximum speed of the motor. (In the case of a jack type receptor, as distinct from a motor, the speed reduction is less, viz. about 2 or 3 per cent.). Now the absolute value of this reduction is virtually independent of the angle of tilt of the pump, that is to say, it is just as great for low speeds as for high speeds of operation. In the latter case the phenomenon as such is of little practical consequence. For operating the crane machinery at very low speeds, however, the resulting indeterminacy of the control lever position for obtaining a certain required speed is a serious drawback with regard to hoisting and lowering motions and even more so with regard to slewing and luffing.

These difficulties can be effectively overcome by the use of a system of servo-mechanisms whereby the control lever does not modify the tilt of the pump directly, but acts indirectly through a regulating system. The basic principle on which such a regulating system operates is that the actual speed of the driven mechanism is compared with the nominal speed corresponding to any particular lever position, discrepancies between the two speeds being continuously " sensed " and fed back as a correcting impulse to the device that varies the angle of tilt of the pump. In this way it is automatically ensured that each position of the lever corresponds to one specific speed of the driven mechanism and that this speed is independent of the magnitude of the load. In particular, when the lever is moved to the zero position, the motion is immediately brought to a standstill without any intervention from braking devices.

It is furthermore necessary to ensure rapid response to the driven mechanism to the manipulation of the control lever—the time lag involved should not exceed 0.1—0.2 seconds—in conjunction with stable operation of the servo-mechanism. This is particularly essential with regard to luffing and slewing motions. Satisfactory solutions to this problem have, however, been devised in the form of special corrector devices.

The question arises as to whether and, if so, to what extent a hydraulic crane is more economical than an electrically-operated one. In seeking to answer this question it is, of course, necessary to compare cranes which are approximately equal in respect of quality of performance. Thus a simple electric crane which is not required to satisfy high demands as to precision and smoothness of control, efficiency, immunity from overloading, etc., will obviously be cheaper than an oil-hydraulic crane of the type under consideration. On the other hand, the latter will undoubtedly cost less than an all-electric crane of comparable performance.

The fact that the electric motors driving the pumps of a hydraulic crane run continuously and at constant speed permits the choice of three-phase A.C. as the source of power. One important advantage of this is that the asynchronous three-phase motor (which may be of the squirrel-cage type) is much more robust than the D.C. motor and requires hardly any maintenance. Owing to the absence of surge effects in the supply mains, it is furthermore possible to connect a larger number of cranes to the same feed cable than would be permissible in the case of ordinary three-phase A.C.-operated cranes. The power consumption of hydraulic cranes compares favourably with that of ordinary cranes.

Oil-hydraulic cranes require less maintenance than do all-electric cranes. With the former, the high-pressure oil serving as the hydraulic medium exercises a self-lubricating action in all the moving parts, thereby reducing wear and tear. Braking is effected without mechanical friction, so that there is no wear in this respect either. Such maintenance and replacement of hydraulic equipment as may from time to time be necessary presents no special difficulties to competent fitters accustomed to dealing with the injection pumps of diesel engines. The hydraulic oil needs renewal only once in about every 5,000 hours of service.

A further, and by no means negligible, advantage is that hydraulic cranes make for greater speed in manipulation and thus achieve a higher productivity, in terms of tons of cargo handled over a given length of time, as compared with ordinary cranes.

Improvements at Durban Harbour

South African Railways and Harbours have announced that the new passenger terminal on the T jetty at Durban will be completed by May 1961. The pre-cooling depot for fruit cargoes will also be in operation by that date and general cargoes will then be handled from the L jetties and M berths. A new general cargo shed at L berth will be ready by July of this year.

Australian Stevedoring Industry Authority

Abstracts from Report for the year ended 30th June 1958

THE Australian Stevedoring Industry Act, 1957, came into force on 12th December, 1957. It amended the Principal Act, which is now cited as the Stevedoring Industry Act, 1956-1957. The amendments now make it necessary to prove only that an employer has prejudiced or interfered with the expeditious **or** safe **or** efficient performing of stevedoring operations. (The wording of the original Act was "expeditious **and** safe **and** efficient.") The amendments also impose on employers an obligation to provide proper supervision "at all times."

The Authority's 1958 report is submitted in seventeen sections. Some of these are mainly of local concern but the following extracts are selections from sections of wider interest. First chosen are reports of two prosecutions under the Act.

Prosecution of Employer under Section 33 of the Act

The first prosecution by the Authority of an employer for a breach of Section 33 of the Stevedoring Industry Act followed a wastage of labour at Townsville caused by the failure of an employer to cancel a labour requisition. The facts, shortly, are that on Friday, 30th August, 1957, the North Queensland Stevedoring and Wooldumping Pty. Ltd. lodged a requisition for 67 men for the vessel "Dubbo" for the day shift on Monday, 2nd September, 1957. At the time the requisition was lodged, the "Dubbo" was loading sugar at Lucinda Point and was scheduled to berth at Townsville during the afternoon of Sunday, 1st September. In fact, the vessel was diverted from Townsville to Mourilyan. The requisition for labour was not cancelled due to the failure of the ship's agents, Samuel Allen & Sons Ltd., to inform the stevedore of the vessel's altered arrangements. As a result, most of the 67 men ordered were discharged on a minimum payment without having worked, there being no work to which they could be transferred during that shift. However, three vessels were short of labour for the night shift and, if the "Dubbo" requisition had been cancelled in time, the labour could have been utilised to advantage.

The Authority prosecuted Samuel Allen & Sons Ltd. in the Commonwealth Industrial Court for contravening Section 33(1)(a) and for failing to comply with Section 33(1)(c)(i) and (ii). The Company pleaded guilty to contravening Section 33(1)(a) and in Townsville on 11th March, 1958, Morgan J. convicted and fined the Company £100 and ordered it to pay 25 guineas costs. The Authority then withdrew the other information as the same facts were involved in each case.

Prosecution of Vigilance Officers by Employers

On 1st November, 1956, the vessel "River Clarence" was discharging pig iron in Sydney. During the evening shift a waterside worker who was working on the wharf receiving cargo from No. 4 hatch, was dismissed after he had refused to carry on alone on the ground that he had been instructed to refuse by a Union official named Isaksen. A stacker who was working with him when the shift commenced had been ordered into No. 4 hold to make up a shortage of holders. Another waterside worker was transferred from No. 3 hatch, but he, too, refused to work, giving the same reason. He was dismissed and two other waterside workers were thereupon transferred from No. 1 hatch to work, but in each case refused to do so after a conversation with the Union official.

On 9th November, 1956, a similar incident occurred on the day shift on the same vessel when, after the foreman had refused to reinstate a gang dismissed at No. 4 hatch for insufficient effort, a Union official named Munro demanded that men who had been working on the wharf and had earlier been ordered to the holds at other hatches to make up shortages there, be restored to their original positions. When this request was refused Munro addressed the men, after which all work on the vessel ceased.

These incidents occurred at a time when the Sydney branch was as a matter of policy actively resisting the changes in methods of work, gang sizes and sling loads, following upon the Sling Loads Judgment and the Waterside Workers' Interim Award.

The employers instituted proceedings against Isaksen and Munro for having, contrary to Section 138 of the Conciliation and Arbitration Act 1904-1956, advised or encouraged waterside workers to refrain from working with an employer who was bound by an award.

On 24th January, 1957, the Chief Industrial Magistrate dismissed the informations. He found that Isaksen had, in fact, advised the first two waterside workers and encouraged the second two waterside workers to stop work and that Munro had advised the day shift men not to work. But he held that in order to establish the offence charged, there must be advice or encouragement not to work **because the work was with an employer bound by the Award,** and he considered that Munro and Isaksen did not give advice and encouragement for that reason, but rather for the reason that the Union wished to bring economic pressure to bear on the employer to force its demands (i.e. for the employment of more men).

The employers lodged appeals in the High Court and the Commonwealth Industrial Court. On 3rd December, 1957, the High Court struck out the appeal as incompetent on the ground that Section 113 of the Conciliation and Arbitration Act 1904-1956 designated the Commonwealth Industrial Court as the appropriate tribunal to hear the appeals and excluded an appeal to the High Court.

The Commonwealth Industrial Court commenced hearing the appeals on 18th February, 1958, and delivered judgment on 6th March, 1958. The Court upheld the appeals on the ground that Section 138 (1) (a) is not confined to cases in which the ground of the advice or encouragement is **merely** the fact that the employer is bound by the Award and that the advice or encouragement given to the waterside workers had, both as to its purpose and to its reason, sufficient relation to the fact that the employer was bound by the Award to constitute offences as charged.

The Court fined Isaksen £40 on the information relating to one of the waterside workers and convicted him without penalty on the other charges. Munro was also fined £40 and both men were ordered to pay costs.

As there were also proceedings in Arbitration Commission in relation to attendance money status, the report states: In "A" class ports, waterside workers are required to make themselves available for work daily and if not engaged on any day they receive attendance money of twenty-four shillings; "B" class ports are those at which attendance is required only on specified days when a pickup is necessary. Attendance money is paid only if a

man is not engaged after attending. Seasonal ports are ports of fluctuating trade in which " A " class status is applicable for part of the year, generally the sugar or meat loading season, after which the port reverts to " B " class status until the next season comes round.

A principle dealt with by the Commonwealth Industrial court concerned a claim for wages by workers dismissed for refusing to obey instructions.

The incident from which this test case originated occurred in Melbourne on 9th July, 1956, when three (3) gangs of waterside workers were engaged to carry out stevedoring operations on the " Tasmania Star." They were allotted to work on the wharf, and commenced at 8.00 a.m. with six men to each of three hatches. The three gangs performed preparatory work as required, but when they were ordered to handle the cargo from the wharf they refused to continue working unless eight men were employed on the wharf to handle cargo for each hatch, the time of such refusals being for those at No. 4 hatch 9.15 a.m., for those at No. 5 hatch 9.45 a.m., and for those at No. 6 hatch 9.55 a.m. Because of their refusal to work as directed the men were dismissed and were not paid wages for the time worked.

Subsequently, the men made a claim on the employer for wages from 8.00 a.m. until the time of their dismissal. Upon refusal it was submitted on 1st and 2nd November, to a Board of Reference which rejected the claim.

The judgment of the Industrial Court was delivered on 11th July, 1957. The Court found that the job for which these wharfmen were engaged on the day in question was to work the ship " Tasmania Star," which included loading it with frozen cargo and work ancillary thereto; that it appeared that at least some of the men did some of the ancillary work, but that when it came to the loading of the cargo itself they refused wrongfully to complete the job; and that their contract was to complete the job in accordance with the provisions of the awards.

The Court decided that the men broke their contract and committed a breach of the awards, for which they could be fined, but that the question then arose whether the contract of employment was entire so that in breaking it, they forfeited any right to wages in respect of that day, or whether on the other hand the contract was divisible and the wages were earned and accrued due each hour.

The Court found that although it was hard on employers that they should be made to pay for preparatory work which was apparently of no benefit to them, the awards must be interpreted according to their terms. In the terms of the awards the men were, in fact, in attendance until the time when they refused to load cargoes and were entitled to receive wages computed in accordance with the provisions of the awards for one hour in each case of their attendance from 8.00 a.m. on 9th July, 1956.

Port Quotas and Recruitment

On this matter, the report states that whenever so requested by the Waterside Workers' Federation or by the employer organisations, and in any event at least once in every twelve months, the Authority is required in terms of the Act to consider and, if necessary, vary the quota of waterside workers for a port.

During the year, numerous quota changes were made and, in the light of a general decline in cargoes handled by waterside workers, the general trend was towards smaller quotas. As at 30th June, 1957, the total of all quotas determined by the Authority stood at 25,382. By 30th June, 1938, this figure had been reduced to 23,126. The total registered strength as at 30th June, 1958, stood at 24,188, i.e. 1,062 in excess of the aggregate quota figure at that date. The Authority has continued the policy which it established in May, 1957, with regard to recruitment of labour, and, except in special and isolated cases, there has been no intake either of new recruits or of former waterside workers.

Amenities

This section is important because its detailed references enable the reader to gain a more intimate appreciation of the atmosphere in which the Australian docker does his work. " Capital expenditure," it is stated, " was again limited to £75,000 for the year under review. Within this limitation, the following work was completed:

At six ports labour bureaux were erected. New equipment was provided for the Authority's cafeterias at several ports, while electrical equipment was installed for snack bar services at Devonport and Port Kembla. A new wharf sanitary block and a heavy duty diesel powered water cooler were provided at Port Alma, Queensland. Two large electric water coolers were supplied at Cairns, two at Bunbury and one at Geraldton. An electric shower unit was installed at Townsville and improvements to wharf sanitary accommodation were made at Bowen, Carrington Basin (Newcastle), Gladstone and Strahan.

Extensive additions to amenities and other facilities for waterside workers were or are being made by the appropriate port authorities. They include the commencement at Sidney, of a large new amenities block and the erection of a new shower block at No. 2 Walsh Bay. The dining rooms and snack bars at No. 7a Berth, Circular Quay and No. 11 Berth, Walsh Bay, were modernised and extended. A start has also been made on a large new amenities block between Berths 7 and 10, Pyrmont and this building will provide dining accommodation for 400 men.

In Brisbane, considerable improvements were made by employers. New amenities blocks were erected at seven wharves and existing buildings at Shirley's Wharf was extended and modernised. At several ports the employers have built new first-aid posts and these have been provided with the latest equipment.

These are only a few examples of the work carried out, but they serve to illustrate the general improvements being made in the standard of working conditions.

Roster Gang Sizes

At the present time, when efforts are being made in ports all over the world to mechanise more and more port work, the question of gang sizes is particularly important. As will be seen from the following extracts, the Australian ports have not escaped troubles in this sphere.

The word " gang " has two meanings in this industry. In one sense it means the number of men who may be required to do a particular task. In this sense it is termed a " working gang." In the other sense it means the number of men who are teamed as a unit by the Labour Bureau for roster purposes. In this sense it is termed a " roster gang." This type of gang may be increased in numbers by extras or, on occasions, decreased in numbers because of the requirements of a particular job but, for the purpose of the roster, it always remains the same.

At these ports where the roster gang system operates, portion of the labour force is formed into roster gangs and the remainder are individuals known as " extras." When a group of men is formed into a roster gang, the Labour Bureau allots that gang a gang number and the gang is rostered and allocated under that number. Men who are not gang members are rostered and allocated to work as extras. The practice is to allocate all gangs in turn from the roster (together with such extras, if any, as may be necessary in each case to build up a roster gang to a working gang of the required size). If, after the gangs have been rostered, there is a shortage of gangs, extras may be made up into what are known as " scratch " gangs and worked in that way as a gang. Conversely, if there is a surplus of gangs and a shortage of " extras," gangs may be temporarily disbanded and their members allocated to work temporarily as extras. The regu-

lar gangs are, usually speaking, more efficient than " scratch " gangs because the men are used to working together. It is both simpler and more economical to allocate labour which has been formed into regular gangs. Furthermore, employers find them more efficient, more co-operative and less liable to internal dissension.

The principal of the roster gang has the support of the employers and the Federation. However, from time to time employers have complained that roster gang units in some ports were too large. They claimed that when they required a working gang numerically less than a roster gang they were forced to choose between either taking a full roster gang, which involved the employment of more men than they needed, or accepting a " scratch " gang of extras who did not have the combined skill of a roster gang and whose output was consequently not as good.

Following the implementation of the Sling Loads Judgment in July, 1956, the problems of the roster gang system were accentuated. Manning scales were reduced in many cases and it was in these circurstances that employers applied for a reduction to 11 men in the size of the roster gang unit in Cairns, Townsville, Brisbane, Sydney, Melbourne, Adelaide and Hobart.

On 28th February, 1958, having considered the submissions of the parties, the Authority fixed the sizes of roster gangs in these ports at 15, except at Adelaide and Hobart where they were made 16 and 13 respectively. The Authority also made provision for the allocation of gangs of a lesser number than the standard roster gang size, where necessary. It provided that where these comprised less than 11 men, they would be normally made up from non-gang members (gangs smaller than the standard size are known as " short " gangs).

On 9th April, unauthorised stoppages occurred in all ports in protest against draft orders which the Authority had circulated to the parties in pursuance of its decision of 28th February. On 18th April, the Authority issued orders for the ports of Brisbane, Sydney, Melbourne and Hobart. Because satisfactory arrangements already existed in the ports of Adelaide, Cairns and Townsville, it was unnecessary to make orders for those ports. The date of operation of the four new orders was fixed at 28th April.

Following the making of the orders, unauthorised stoppages occurred in protest against the allocation of short gangs in Sydney, Brisbane and Melbourne, and all such gangs allocated refused to work. On 29th April, on the application of the Commonwealth Steamship Owners' Association, the Commonwealth Industrial Court made an order calling upon the Waterside Workers' Federation to show cause why it should not be restrained from committing or continuing alleged breaches of the Award. On 1st May, 1958, the Sydney, Brisbane and Melbourne branches informed the Authority that as from 8.00 a.m. on Friday, 2nd May, waterside workers in those ports would work in accordance with the Authority's orders.

Safe Working of Gear and Accident Prevention

Although the Authority has no powers to ensure safe working in stevedoring operations, one of its functions is to encourage it. Thus, during the year the Authority has been concerned at reports from a number of ports relating to inadequately secured beams, wire splices which did not comply with the Navigation (Loading and Unloading) Regulations, and standing and running gear which had deteriorated into an unsafe condition because of neglect. Those factors involved safety issues as well as interference with the performance of stevedoring operations within the meaning of the Stevedoring Industry Act, 1956.

The Authority took up the question of unsecured beams on the highest level with shipowners and stevedores, as a result of which instructions were issued to Masters and Chief Officers of vessels on arrival at the first Australian port to pay particular attention to this matter. An improvement has been noticed since this was done.

The other problems fall within three categories:—

The first category are ships which have first-class gear in every respect except that the wire runners have been spliced in a manner which does not strictly comply with the provisions of Regulation 18 of the Loading and Unloading Regulations. In some of these cases the Navigation Inspector has insisted on the wires being re-spliced, while in others he has required bulldog grips to be fitted and the safe working load reduced as a temporary safety measure. In these instances the delay to stevedoring operations is not lengthy and, as the splices are readily accessible for inspection, accidents very seldom occur from this cause.

The second category are ships on which, from a visual inspection, all the gear appears to be in first-class condition and the relative certificates are in order but an accident occurs without any warning.

A case such as this happened in the port of Fremantle in November, 1957, when one waterside worker was killed and another injured. The vessel concerned was the m.v. "Graig," a British ship stevedored by the British Phosphate Commissioners. At the Coroner's inquiry it was found that a splico had drawn on the topping lift of the No. 3 port derrick. This part of the gear had been shackled on to the Samson post about 30-ft. above the deck level, and it would be most unusual in practice for this gear to be inspected by other than the ship's complement before work began. The Navigation Inspector who happened to be on board when the accident occurred found on examination that the splice could only have had three complete tucks and that the splice had been served over, which would make visual inspection impossible unless the serving was first removed. In view of the obvious fault in the splicing, the Master of the vessel was prosecuted for a breach of the Loading and Unloading Regulations and was fined £50.

In the third category, are ships where the gear has been allowed to deteriorate due to lack of maintenance by the ship's complement and when these vessels are inspected by the Navigation Inspector, he usually orders a large amount of replacement and renewal of gear before the vessel is allowed to begin stevedoring operations. In some of these cases prosecutions have been successfully instituted by the Department of Navigation.

As the compensation figures show, there can be little doubt that there is room for considerable improvement in accident prevention in stevedoring operations in some ports. The Authority has devoted close attention to this problem in the past and, while continuing its present policy of maintaining the closest co-operation with the Director of Navigation and his officers with regard to safety on the ship, it proposes to assist with the broad problem of accident prevention in the ports.

Time Lost Through Industrial Stoppages

During the year, 1,484,158 man hours were lost as a result of industrial stoppages. This represented 4.8% of the total number of man hours worked, whereas in the previous year the figure was 3.7%. A dissection of the time lost in terms of the issues involved is shown in the tables on the following page.

Pertinent to the details of hours worked and earnings is the section dealing with

Mechanisation and Improved Methods. Greater use of mechanisation and improved handling methods helped to accelerate the flow of cargo during the year. New cargo handling techniques, many of which have been developed because of oversea experience, have resulted in considerable improvements in rates of work and shipping turn-round. Within the next few years it is expected that more mechanical equipment, im-

NUMBER OF HOURS LOST THROUGH STOPPAGES 1957/58

Nature of Issue or Type of Stoppage (as reported)	Jul.-Sep. Quarter	Oct.-Dec. Quarter	Jan.-Mar. Quarter	Apr.-Jun. Quarter	1957/58 Total
24 Hour Stoppages ...	19,040	124,718	110,926	133,803	388,487
Disciplinary Measures and sling loads dispute	20,100	356,635	1,858	1,491	380,084
Manning Stoppages ...	449	233	215,491	44,392	260,565
Working Procedures or Conditions ...	44,507	123,700	29,320	15,364	212,891
Australia-wide Stoppage	—	—	—	73,469	73,469
Other Issues—					
Opposition to Employers' or Authority's Administrative Arrangements	8,783	503	2,207	22,949	34,442
Demarcation Stoppages	2,127	521	21,304	—	23,952
Failure to Observe Correct Rest Periods (d) ...	1,784	13,976	967	238	16,965
Refusal to work Overtime ...	3,818	2,536	987	1,865	9,206
Transfers ...	5,732	2,094	772	213	8,811
Holiday Work ...	4,262	—	—	—	4,262
Miscellaneous ...	19,175	9,167	22,748	19,934	71,024
Total	129,777	634,083	406,580	313,718	1,484,158

The total number of man hours lost through industrial stoppages for each year since 1946/47 is as follows:—

Year	Total man hours worked	Man hours lost through stoppages	Man hours lost through stoppages as % of man hours worked
1946/47	30,637,850	1,773,600	5.8
1947/48	32,622,000	734,800	2.2
1948/49	36,343,400	647,700	1.8
1949/50	37,064,675	849,265	2.3
1950/51	40,457,293	2,201,778	5.4
1951/52	40,864,019	1,883,552	4.6
1952/53	33,999,561	1,067,131	3.1
1953/54	37,189,741	1,680,695	4.5
1954/55	40,358,012	2,675,893	6.6
1955/56	38,821,196	3,353,718	8.6
1956/57	34,173,610	1,281,,774	3.7
1957/58	31,023,363	1,484,158	4.8

Weekly averages of hours worked and earnings per waterside worker of the real labour force for all Australian ports are quoted as follows:—

Year	Hours Worked	Wages	Attendance Money	Sick Pay	Public Holidays (not worked)	Gross Earnings
1956/57	26·9	17 1 0	1 6 2	2 3	13 5	19 2 10
1957/59	25·1	16 8 6	1 8 5	5 1	10 0	18 12 0

proved port facilities and better vessel design will lead to further major changes in stevedoring practices.

These developments are particularly important to the national economy at a time when there is a need for greater exports to overcome the current balance of payments difficulties. Only better handling methods can help interstate shipping to recapture part of the trade lost to land transport over recent years.

Some of these changes have had serious repercussions on waterfront employment. The development of bulk handling facilities, for example, has already resulted in the displacement of many waterside workers. More bulk handling facilities are contemplated.

Examples of improved facilities and methods are as follows:—

Bulk Handling

The construction of mechanical bulk installations for handling sugar, grain and coal was an outstanding feature of the year. The Mackay bulk sugar terminal came into operation at the beginning of the year and new bulk terminals were completed at Lucinda Point and Bundaberg in readiness for the 1958 sugar season. Progress was also made in the preparation of the sites for new sugar terminals at Townsville and Mourilyan. Within a few years almost all sugar will be handled mechanically. Facilities for loading bulk grain at Wallaroo, Port Lincoln and Brisbane and for discharging bulk grain at Launceston and Hobart were being constructed during the year. It is anticipated that next year almost all wheat shipped from Australian ports will be handled in bulk. A mechanical coal loader was installed at Newcastle and a new dock for discharging bulk coal was completed at Melbourne. At Port Adelaide, bulk phosphate is now discharged by the Osborne coal handling plant without waterside workers being employed. At Sydney, the building of a plant to handle soda ash in bulk was commenced.

Pre-Slinging, Pallets and Containers

Following the very high rates of work achieved last year at Newcastle and Kwinana in the loading and discharging of preslung iron and steel by luffing crane, two more cranes were installed at Newcastle and new berths equipped with cranes were constructed at Melbourne and Port Adelaide during the year. The new berths at Port Adelaide were used towards the end of the year and those at Melbourne will soon be in full use. In the near future approximately 80% of iron and steel shipped interstate from Newcastle will be pre-slung. Pre-slinging of iron and stell will soon be introduced at Port Kembla. Other cargoes which were handled in this manner at some of the major ports during the year were bagged salt, bagged soda ash, timber packs and newsprint.

Pallets were used for a wide range of overseas and interstate cargoes during the year. General cargo, drum cargo, butter, cement, hides and mineral sands are examples of cargoes loaded on pallets. Some inward overseas cargoes were also found to have been loaded on pallets.

The use of light and durable containers in interstate trade was another important development. Some of these containers are fitted with rollers to facilitate movement on the shore and on the vessel and when loaded weigh approximately 5 tons. Already containers are being used fairly extensively between the capital cities of the eastern States. Wire cages are being used for handling cargo in cartons and small cases.

Vessel Design. Towards the end of the year, tenders were called for the construction of a roll-on, roll-off cargo ship for the Melbourne-Tasmania trade. A roll-on, roll-off car and passenger ferry has been ordered for service over the same route. The new vehicle deck cargo ship will carry semi-trailers, trucks, containers and new motor vehicles and it is expected that it will come into operation late in 1960.

New vessels of shallow draught design suited to the conditions of Queensland meat ports were introduced during the year to carry chilled beef overseas via the "north-about" route. With these vessels, the time of voyage from a north Queensland port to the United Kingdom via Torres Strait would be approximately 28-30 days.

Self trimming vessels were again used in the bulk cargo trade.

Mechanical Equipment and New Berths. Augers were used during the year to handle bulk cargoes such as wheat, barley, concentrates and sulphur. Trimming of bulk cargoes was often carried out with bulldozers, calfdozers and frontend loaders. At Melbourne a magnet attached to a mobile crane was used to load scrap metal. Although employers were prepared to make greater use of fork-lifts in the hold as well as on the wharf, demarcation disputes restricted their use at some ports.

Progress was made at a number of ports in the construction of berths and cargo sheds where mechanical equipment could be used to advantage.

Finance

During the year 1957/58 the financial position of the Authority continued to decline. The levy of 2s. which applied from 21st

lar gangs are, usually speaking, more efficient than "scratch" gangs because the men are used to working together. It is both simpler and more economical to allocate labour which has been formed into regular gangs. Furthermore, employers find them more efficient, more co-operative and less liable to internal dissension.

The principal of the roster gang has the support of the employers and the Federation. However, from time to time employers have complained that roster gang units in some ports were too large. They claimed that when they required a working gang numerically less than a roster gang they were forced to choose between either taking a full roster gang, which involved the employment of more men than they needed, or accepting a "scratch" gang of extras who did not have the combined skill of a roster gang and whose output was consequently not as good.

Following the implementation of the Sling Loads Judgment in July, 1956, the problems of the roster gang system were accentuated. Manning scales were reduced in many cases and it was in these circurstances that employers applied for a reduction to 11 men in the size of the roster gang unit in Cairns, Townsville, Brisbane, Sydney, Melbourne, Adelaide and Hobart.

On 28th February, 1958, having considered the submissions of the parties, the Authority fixed the sizes of roster gangs in these ports at 15, except at Adelaide and Hobart where they were made 16 and 13 respectively. The Authority also made provision for the allocation of gangs of a lesser number than the standard roster gang size, where necessary. It provided that where these comprised less than 11 men, they would be normally made up from non-gang members (gangs smaller than the standard size are known as "short" gangs).

On 9th April, unauthorised stoppages occurred in all ports in protest against draft orders which the Authority had circulated to the parties in pursuance of its decision of 28th February. On 18th April, the Authority issued orders for the ports of Brisbane, Sydney, Melbourne and Hobart. Because satisfactory arrangements already existed in the ports of Adelaide, Cairns and Townsville, it was unnecessary to make orders for those ports. The date of operation of the four new orders was fixed at 28th April.

Following the making of the orders, unauthorised stoppages occurred in protest against the allocation of short gangs in Sydney, Brisbane and Melbourne, and all such gangs allocated refused to work. On 29th April, on the application of the Commonwealth Steamship Owners' Association, the Commonwealth Industrial Court made an order calling upon the Waterside Workers' Federation to show cause why it should not be restrained from committing or continuing alleged breaches of the Award. On 1st May, 1958, the Sydney, Brisbane and Melbourne branches informed the Authority that as from 8.00 a.m. on Friday, 2nd May, waterside workers in those ports would work in accordance with the Authority's orders.

Safe Working of Gear and Accident Prevention

Although the Authority has no powers to ensure safe working in stevedoring operations, one of its functions is to encourage it. Thus, during the year the Authority has been concerned at reports from a number of ports relating to inadequately secured beams, wire splices which did not comply with the Navigation (Loading and Unloading) Regulations, and standing and running gear which had deteriorated into an unsafe condition because of neglect. Those factors involved safety issues as well as interference with the performance of stevedoring operations within the meaning of the Stevedoring Industry Act, 1956.

The Authority took up the question of unsecured beams on the highest level with shipowners and stevedores, as a result of which instructions were issued to Masters and Chief Officers of vessels on arrival at the first Australian port to pay particular attention to this matter. An improvement has been noticed since this was done.

The other problems fall within three categories:—

The first category are ships which have first-class gear in every respect except that the wire runners have been spliced in a manner which does not strictly comply with the provisions of Regulation 18 of the Loading and Unloading Regulations. In some of these cases the Navigation Inspector has insisted on the wires being re-spliced, while in others he has required bulldog grips to be fitted and the safe working load reduced as a temporary safety measure. In these instances the delay to stevedoring operations is not lengthy and, as the splices are readily accessible for inspection, accidents very seldom occur from this cause.

The second category are ships on which, from a visual inspection, all the gear appears to be in first-class condition and the relative certificates are in order but an accident occurs without any warning.

A case such as this happened in the port of Fremantle in November, 1957, when one waterside worker was killed and another injured. The vessel concerned was the m.v. "Graig," a British ship stevedored by the British Phosphate Commissioners. At the Coroner's inquiry it was found that a splico had drawn on the topping lift of the No. 3 port derrick. This part of the gear had been shackled on to the Samson post about 30-ft. above the deck level, and it would be most unusual in practice for this gear to be inspected by other than the ship's complement before work began. The Navigation Inspector who happened to be on board when the accident occurred found on examination that the splice could only have had three complete tucks and that the splice had been served over, which would make visual inspection impossible unless the serving was first removed. In view of the obvious fault in the splicing, the Master of the vessel was prosecuted for a breach of the Loading and Unloading Regulations and was fined £50.

In the third category, are ships where the gear has been allowed to deteriorate due to lack of maintenance by the ship's complement and when these vessels are inspected by the Navigation Inspector, he usually orders a large amount of replacement and renewal of gear before the vessel is allowed to begin stevedoring operations. In some of these cases prosecutions have been successfully instituted by the Department of Navigation.

As the compensation figures show, there can be little doubt that there is room for considerable improvement in accident prevention in stevedoring operations in some ports. The Authority has devoted close attention to this problem in the past and, while continuing its present policy of maintaining the closest co-operation with the Director of Navigation and his officers with regard to safety on the ship, it proposes to assist with the broad problem of accident prevention in the ports.

Time Lost Through Industrial Stoppages

During the year, 1,484,158 man hours were lost as a result of industrial stoppages. This represented 4.8% of the total number of man hours worked, whereas in the previous year the figure was 3.7%. A dissection of the time lost in terms of the issues involved is shown in the tables on the following page.

Pertinent to the details of hours worked and earnings is the section dealing with

Mechanisation and Improved Methods. Greater use of mechanisation and improved handling methods helped to accelerate the flow of cargo during the year. New cargo handling techniques, many of which have been developed because of oversea experience, have resulted in considerable improvements in rates of work and shipping turn-round. Within the next few years it is expected that more mechanical equipment, im-

NUMBER OF HOURS LOST THROUGH STOPPAGES 1957/58

Nature of Issue or Type of Stoppage (as reported)	Jul.-Sep. Quarter	Oct.-Dec. Quarter	Jan.-Mar. Quarter	Apr.-Jun. Quarter	1957/58 Total
24 Hour Stoppages ...	19,040	124,718	110,926	133,803	388,487
Disciplinary Measures and sling loads dispute	20,100	356,635	1,858	1,491	380,084
Manning Stoppages ...	449	233	215,491	44,392	260,565
Working Procedures or Conditions ...	44,507	123,700	29,320	15,364	212,891
Australia-wide Stoppage	—	—	—	73,469	73,469
Other Issues—					
Opposition to Employers' or Authority's Administrative Arrangements	8,783	503	2,207	22,949	34,442
Demarcation Stoppages	2,127	521	21,304	—	23,952
Failure to Observe Correct Rest Periods (d) ...	1,784	13,976	967	238	16,965
Refusal to work Overtime ...	3,818	2,536	987	1,865	9,206
Transfers ...	5,732	2,094	772	213	8,811
Holiday Work ...	4,262	—	—	—	4,262
Miscellaneous ...	19,175	9,167	22,748	19,934	71,024
Total	129,777	634,083	406,580	313,718	1,484,158

The total number of man hours lost through industrial stoppages for each year since 1946/47 is as follows:—

Year	Total man hours worked	Man hours lost through stoppages	Man hours lost through stoppages as % of man hours worked
1946/47	30,637,850	1,773,600	5.8
1947/48	32,622,000	734,800	2.2
1948/49	36,343,400	647,700	1.8
1949/50	37,064,675	849,265	2.3
1950/51	40,457,293	2,201,778	5.4
1951/52	40,864,019	1,883,552	4.6
1952/53	33,999,561	1,067,131	3.1
1953/54	37,189,741	1,680,695	4.5
1954/55	40,358,012	2,675,893	6.6
1955/56	38,821,196	3,353,718	8.6
1956/57	34,173,610	1,281,,774	3.7
1957/58	31,023,363	1,484,158	4.8

Weekly averages of hours worked and earnings per waterside worker of the real labour force for all Australian ports are quoted as follows:—

Year	Hours Worked	Wages	Attendance Money	Sick Pay	Public Holidays (not worked)	Gross Earnings
1956/57	26·9	17 1 0	1 6 2	2 3	13 5	19 2 10
1957/59	25·1	16 8 6	1 8 5	5 1	10 0	18 12 0

proved port facilities and better vessel design will lead to further major changes in stevedoring practices.

These developments are particularly important to the national economy at a time when there is a need for greater exports to overcome the current balance of payments difficulties. Only better handling methods can help interstate shipping to recapture part of the trade lost to land transport over recent years.

Some of these changes have had serious repercussions on waterfront employment. The development of bulk handling facilities, for example, has already resulted in the displacement of many waterside workers. More bulk handling facilities are contemplated.

Examples of improved facilities and methods are as follows:—

Bulk Handling

The construction of mechanical bulk installations for handling sugar, grain and coal was an outstanding feature of the year. The Mackay bulk sugar terminal came into operation at the beginning of the year and new bulk terminals were completed at Lucinda Point and Bundaberg in readiness for the 1958 sugar season. Progress was also made in the preparation of the sites for new sugar terminals at Townsville and Mourilyan. Within a few years almost all sugar will be handled mechanically. Facilities for loading bulk grain at Wallaroo, Port Lincoln and Brisbane and for discharging bulk grain at Launceston and Hobart were being constructed during the year. It is anticipated that next year almost all wheat shipped from Australian ports will be handled in bulk. A mechanical coal loader was installed at Newcastle and a new dock for discharging bulk coal was completed at Melbourne. At Port Adelaide, bulk phosphate is now discharged by the Osborne coal handling plant without waterside workers being employed. At Sydney, the building of a plant to handle soda ash in bulk was commenced.

Pre-Slinging, Pallets and Containers

Following the very high rates of work achieved last year at Newcastle and Kwinana in the loading and discharging of pre-slung iron and steel by luffing crane, two more cranes were installed at Newcastle and new berths equipped with cranes were constructed at Melbourne and Port Adelaide during the year. The new berths at Port Adelaide were used towards the end of the year and those at Melbourne will soon be in full use. In the near future approximately 80% of iron and steel shipped interstate from Newcastle will be pre-slung. Pre-slinging of iron and stell will soon be introduced at Port Kembla. Other cargoes which were handled in this manner at some of the major ports during the year were bagged salt, bagged soda ash, timber packs and newsprint.

Pallets were used for a wide range of overseas and interstate cargoes during the year. General cargo, drum cargo, butter, cement, hides and mineral sands are examples of cargoes loaded on pallets. Some inward overseas cargoes were also found to have been loaded on pallets.

The use of light and durable containers in interstate trade was another important development. Some of these containers are fitted with rollers to facilitate movement on the shore and on the vessel and when loaded weigh approximately 5 tons. Already containers are being used fairly extensively between the capital cities of the eastern States. Wire cages are being used for handling cargo in cartons and small cases.

Vessel Design. Towards the end of the year, tenders were called for the construction of a roll-on, roll-off cargo ship for the Melbourne-Tasmania trade. A roll-on, roll-off car and passenger ferry has been ordered for service over the same route. The new vehicle deck cargo ship will carry semi-trailers, trucks, containers and new motor vehicles and it is expected that it will come into operation late in 1960.

New vessels of shallow draught design suited to the conditions of Queensland meat ports were introduced during the year to carry chilled beef overseas via the " north-about " route. With these vessels, the time of voyage from a north Queensland port to the United Kingdom via Torres Strait would be approximately 28-30 days.

Self trimming vessels were again used in the bulk cargo trade.

Mechanical Equipment and New Berths. Augers were used during the year to handle bulk cargoes such as wheat, barley, concentrates and sulphur. Trimming of bulk cargoes was often carried out with bulldozers, calfdozers and frontend loaders. At Melbourne a magnet attached to a mobile crane was used to load scrap metal. Although employers were prepared to make greater use of fork-lifts in the hold as well as on the wharf, demarcation disputes restricted their use at some ports.

Progress was made at a number of ports in the construction of berths and cargo sheds where mechanical equipment could be used to advantage.

Finance

During the year 1957/58 the financial position of the Authority continued to decline. The levy of 2s. which applied from 21st

May, 1957, proved insufficient to meet the obligations of the Authority which included substantial award payments to waterside workers on behalf of employers. As a result the previous year's accumulated deficit increased by a further £85,942.

This further deterioration in the Authority's finances was caused by the severe fall in man hours worked during the year. Some 34.2 million man hours were worked in 1956/57. Estimates made shortly before the levy of 2s. was imposed suggested that the 1957/58 man hours figure would be in the vicinity of 36.5 million. As the 1957/58 season progressed, however, it became apparent that drought conditions were having an adverse effect on the volume of cargo shipped through Australian ports, particularly on the tonnage of primary products loaded for oversea shipment. Moreover, with increased efficiency in cargo handling, there were fewer opportunities for waterfront employment. As shown elsewhere in this Report, the actual number of man hours worked in 1957/58 was only slightly above 31 million.

This was 5.5 million less than the anticipated figure, and income for the year was consequently £550,000 less than anticipated. On the other hand, attendance money payments increased with the decline in employment. Although the industry's work force fell during the year—a factor which might have been expected to have reduced the number of attendance money payments — this was more than offset by the decline in work opportunity.

During the three months ended September, 1957, there was no improvement in the overdraft position and the Authority, mindful of its heavy statutory commitments for public holiday pay in the latter half of the year, and the long term nature of the man hour reductions, sought an increase in the levy to avert further financial deterioration, liquidate the overdraft, and provide working reserves of cash. By the Stevedoring Industry Charge Act 1958 the levy was increased to 3s. from 1st April, 1958, until 30th June, 1959. Thereafter the rate is to be 2s. 6d.

The benefit of this increase was not received by the Authority until June, 1958. In order to contain its overdraft at the Commonwealth Bank within the limit of £470,000 a special advance of £250,000 against the anticipated increased levy revenue was provided by the Department of the Treasury at the beginning of April. This advance was repaid during June.

INCOME

Total income for the year was £3,338,465, an increase of £1,406,429 over 1956/57.

Man hours worked during the year were 31 million, approximately, a reduction of some 3.2 million below 1956/57.

EXPENDITURE

Main items of expenditure were:

Attendance Money	£1,701,544
Sick Leave paid or accrued	379,366
Holiday Pay	616,432
Other payments to or for Waterside Workers ...	166,190
Total payments to or for Waterside Workers ...	£2,863,532
Administration, including labour bureau operations, sundries and adjustments	560,896
Total Expenditure	£3,424,428
Excess Expenditure over Income	£85,963

The report, which is addressed to the Australian Minister for Labour and National Service, runs into 83 pages. It is well illustrated and besides many tables to amplify the text, there are sixteen extremely detailed appendices.

Prevention of Oil Pollution

A new British discovery, it is claimed, can make a significant contribution to the prevention of oil pollution of the sea. A surface-active agent which was specially designed by research scientists of D.S.I.R. and a Yorkshire chemical company to overcome certain boiler troubles in ships, has proved successful and trials have now shown two other very important uses. The first is for tank cleaning in dockyards; the second is for the cleaning of tanker washings at sea, the disposal of which can be a major source of pollution. With the use of this agent, dry oil is recovered which can be used or sold. The great advantage of the agent, which is believed to be superior to any similar agent available in the United Kingdom or abroad, is that more than 80 per cent can be recovered for re-use. The agent is now marketed under the name of "Fomescol."

The furnace fuel oil burnt in marine boilers is liable to form stable emulsions when contaminated with sea water. Such emulsions cause a number of troubles; chief of these are corrosion of tubes and slagging of refractories making frequent re-tubing and relining of furnaces necessary.

The stability of the emulsions varies considerably with the source of the oil fuel, but if conditions of emulsification are sufficently severe, stable emulsions can be made with practically any furnace fuel oil. British ships which put salt water ballast into oil fuel tanks when the oil has been used or discharged, are required by law to use an oily water separator when deballasting, but the oil recovered from such a separator can contain as much as 30 per cent sea-water (by weight). These mixtures can be indistinguishable from dry oil to the naked eye.

The Fuel Research Station, D.S.I.R., was asked by the Admiralty to undertake an investigation of this problem. To begin with, all possible methods of de-emulsification were examined at the Station, such as addition of salts, use of steam, electrical techniques and filtration. The addition of surface-active agents was found to be the most promising. As facilities were not available at the Station, a chemical manufacturer agreed to co-operate in developing an agent. The work comprised a study of the effects of systematic variations of the molecular structure of certain compounds on their efficiency as emulsion breakers.

In this way an efficient molecular structure was brought to light and this agent has now been patented jointly under the name of "Fomesco' by D.S.I.R. and Glovers (Chemicals), Ltd., Leeds.

A series of trials were carried out by the Admiralty and Fomescol was found to be entirely satisfactory. It shows no specificity in action with any oil so far examined, nor is any critical concentration shown. In use about 0.01 parts of the agent dissolved in water is mixed with 100 parts of oil; the oil is then heated to 140 deg. F. for 12-24 hours, when the water separates to the bottom with a clean interface. These particular boiler troubles have thus been solved.

A further series of trials was then undertaken by the Admiralty on tank cleaning in dockyards. Again the results were satisfactory, the oil being recovered and more than 80 per cent of the agent also being recovered for re-use. This is the first time that such a claim has appeared for any surface-active agent on the world market.

The tanks of tankers are frequently cleaned at sea, the normal method being to wash them with sea water, the resulting mixture of oil and salt water being collected and stored in one tank. If this mixture cannot be discharged ashore it must be pumped into the sea. With Fomescol the oil can be recovered dry and sold, so that dumping of the residues will no longer be necessary. The cost is low, due mainly to the repeated re-use of the recovered solution.

Trent and Mersey Canal Improvements

Works at Thurlwood Upper Lock and Marston New Cut

The section of the Trent and Mersey Canal on which the following improvement works have recently been completed lies between Anderton and Stoke-on-Trent. This canal was originally engineered by James Brindley about 1766, and now passes annually some 60,000 tons of traffic between the Mersey ports, Manchester, and the Potteries and Midlands. The new works now completed comprise a pre-fabricated steel tank lock at Thurlwood and a 1,750-ft. deviation of the canal at Marston which is believed to be the first section of canal to be cut in this country for over 50 years.

The Trent and Mersey Canal passes through an area in Mid Cheshire which is subject to subsidence resulting from the pumping of brine. The effect of subsidence varies in magnitude depending upon the proximity of mine shafts and the activity of subterranean brine streams, which incidentally, are in the main uncharted.

At Thurlwood, Nr. Sandbach, a salt mine, some 300-ft. from the canal, was abandoned in 1927 due to the collapse of a shaft. Also about that time the River Wheelock which ran alongside the shaft changed its course and part of its water discharged down the shaft so aggravating the already precarious conditions in the shaft and mine. Severe local subsidence quickly followed but it was not until the mid 1930's that the effect was felt at the canal. By 1939 the position was serious and repairs to the towing path were becoming extensive. During the last war conditions worsened and by 1950 the subsidence had extended to Thurlwood Upper Locks which lie about a quarter of a mile from the disused shaft.

New Works at Thurlwood

There are two locks at Thurlwood, side by side, known as the towpath lock and the offside lock respectively. The towpath lock was damaged first and repairs were undertaken, but by 1953, the offside lock was also affected and repairs to both locks were becoming almost continuous; the towpath lock being entirely rebuilt in traditional brick and masonry materials.

Below the locks a double arch brick bridge became unsafe and this eventually had to be demolished and replaced with a temporary steel beam and timber deck bridge.

By this time it was clear that considerable works would be needed to keep the canal open and that the traditional methods using bricks would have to be superseded and a structure capable of withstanding differential ground settlement would be necessary. Various schemes were considered but eventually a steel framed tank design was chosen, mainly as a result of experience gained with an aqueduct at Middlewich where similar conditions exist.

The new lock, therefore, had two functions to perform:—

(1) Convey the canal in an aqueduct.
(2) Change the level of the canal from upper to lower ponds.

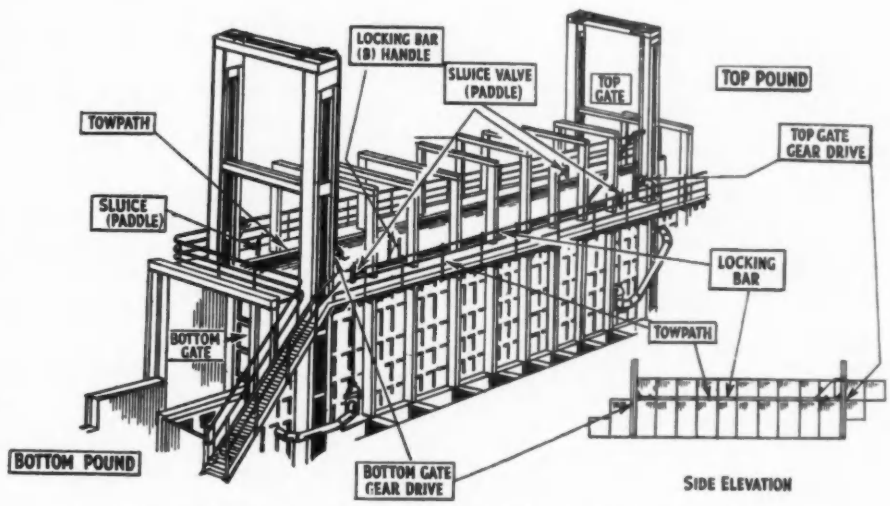
The canal was to be kept open whilst the new works were in progress and the offside lock was thoroughly repaired and overhauled early in 1956 to enable the towpath lock to be demolished behind cofferdams. A new prestressed concrete bridge was erected on the site of the brick arched bridges to give access for heavy plant and machinery.

The principal design considerations were:—

(1) Length and breadth of chamber to accommodate a " narrow boat " 72-ft. long by 7-ft. beam.
(2) Watertightness.
(3) Structure to withstand differential settlement.
(4) Provisions for correcting lines and levels as subsidence takes place.
(5) Support for offside lock during, and subsequent to, construction of new lock.
(6) Lock gates.
(7) Sluices.

The lock has a rise of 9-ft. 9-in. and the depth of the upper and lower approaches to the main chamber have been extended sufficiently to allow for a settlement of 2-ft. 6-in. before major raising operations need be undertaken. The maximum depth of water in the main chamber when the lock is full is normally 15-ft. 3-in. but this may reach 17-ft. 9-in. when maximum subsidence has taken place.

When the towpath lock has been demolished a mass concrete gravity retaining wall was built to support the offside lock and to form part of the chamber into which the new lock has been built. This wall, 22-ft. deep, with clay puddle to ensure watertightness of the offside lock. The vertical members of the lock are 24-in. x $7\frac{1}{2}$-in. x 95 lb. x 26-ft. 9-in. R.S.J.'s, these are tied at the top with 10-ft. 8-in. x 55 lb. R.S.J.'s and at the bottom with 12-in. x 8-in. x 65 lb. R.S.J.'s, each of these are 13-ft. 3-in. long. All plating in the sides and bottom of the lock is $\frac{3}{8}$-in. thick.

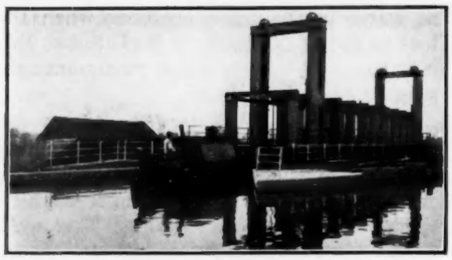


Perspective drawing showing the arrangement of the steel tank lock at Thurlwood.

Each main frame is supported on a concrete stool into which jacking pockets have been built to receive hydraulic jacks of up to 100 tons capacity. The main frames are at 8-ft. centres. The upper and lower approaches are supported on concrete headwalls; these also support a clay puddle core and as this clay is rammed tightly against the sides and bottom of the lock approaches it forms the watertight seal.

The structure has been designed to withstand stresses set up by ground settlement of at least one-third of the total length of the lock to a greater extent than settlement of the remaining two-thirds. Brine subsidence is such that no prediction can be made of the total settlement nor can the time of settlement be forecast. Furthermore, subsidence is often sudden and localised, consequently any part of the structure may be left unsupported for some time before remedial measures can be undertaken.

Access to the lock operating gear and to



Narrow boat entering the top gate at Thurlwood Upper Lock.

craft in the lock is provided by footwalks on both sides, each of which is 4-ft. wide and surfaced with asphalt.

The sluice pipes and valves are fitted externally; there are two sluices at the upper end to fill the lock and two at the lower end to empty. All pipes and valves are 1-ft. 6-in. diameter, and in principle, based upon traditional canal lock equipment.

Balanced steel guillotine gates with L section rubber seal were selected because of their simplicity, avoiding the need for intricate castings and expensive steel work in forming quoins, heels and mitres. To prevent both gates being raised at the same time an attachment is fitted.

The steelwork was prefabricated at the contractors' works in Glasgow and sections were then delivered by road to the site for final erection.

The leading dimensions of the lock are:—

Overall length	106-ft.
Overall height	45-ft.
Overall width	18-ft.
Length of lock chamber ...	72-ft.
Width of lock chamber ...	7-ft. 9-in.
Depth of lock chamber ...	18-ft.
Steel tonnage	180 tons

The lock has been in regular use since 19th May, 1958, but up to date no adjustment has been necessary due to settlement.

The Marston New Cut

Disused shafts which formed part of the old salt-mining area also created the precarious position which existed on the Trent and Mersey Canal at Marston. The discovery of natural rock salt at Marbury has meant almost three centuries of salt-mining in the area and to-day Northwich is still an important centre of the salt industry, producing nearly 80 per cent. of the country's total production.

When the workings were abandoned one of four shafts, only a few feet away from the canal towing path and descending 300-ft., was not properly sealed, with the result that, over the years, salt solution has enlarged the underground cavity and caused the original brick lining of the shaft to collapse. The edge of the conical crater, where the shaft reached the surface, came dangerously close to the original section of the canal and on one occasion in recent years reached the clay puddle behind the canal wall.

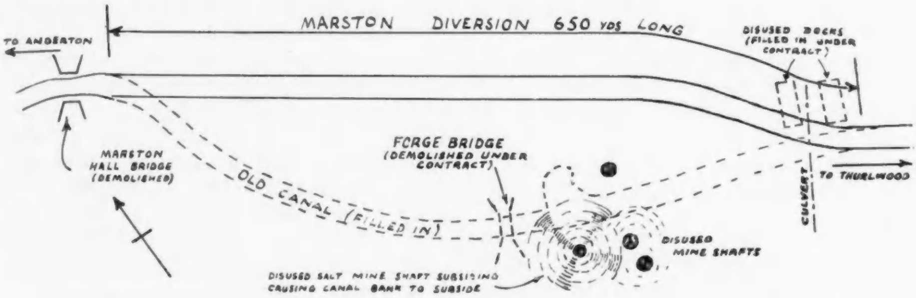
In an attempt to block the old shaft, thousands of tons of material were dropped into the cavity to form a plug, but this proved to be unsuccessful and the subsidence of these plugs has become more frequent and more extensive. Since 1928 there has been a constant danger of the crater reaching the canal when the inflow of water would scour out a large hole and also completely drain the adjoining section of the canal. The fill in the shaft has fallen as much as 45-ft. overnight.

A critical examination of the affected area revealed that the danger to the canal bank was likely to increase and that further tippings would not prove a satisfactory permanent remedy.

It was therefore decided that the only way to alleviate a potential threat to navigation on this busy section of the canal was to cut a completely new diversion from the immediate locality of the shafts. The project was started in late summer, 1957, and with bad weather severely handicapping the work, the diversion was ultimately completed in March, 1958.

Technical Details

Length of diversion	1,750-ft.
Overall width	55-ft.
Width at normal waterline ...	40-ft.
Depth	5-ft.
Bed width	20-ft.
Width of towpath	8-ft.
Depth of concrete walls ...	4-ft. to 12-ft.
Width of concrete walls	2-ft.
Depth of steel piling ...	9-ft. to 18-ft.
Length of steel piling	750-ft.



Sketch plan of Marston New Cut showing course of old canal, and disused mine shafts.

Because it was not possible to cut a new channel clear of the general subsidence area, provision had to be made for future raising and for effective watertight seals. The new line crosses the site of an old dry dock and a disused wet dock, and it was necessary to sever these completely from the new channel.

A 100-ft. wide seam of running sand was encountered about half-way along the channel and this meant that the diversion's offside had to be piled through the seam of running sand. The new route will be subject to the normal brine subsidence of the area and in order to raise the canal, both the towpath and the offside have 2-ft. thick concrete waterway walls extending down to firm ground. Behind the walls are clay puddle cores 3-ft. thick and pressed down to the bed level of the concrete walls.

Narrow boats on the new section of the canal.

Where the side of the canal bank furthest away from the towing-path crosses the old dry dock the concrete wall has been extended to about 1-ft. 6-in. below the invert level of the dock and founded on good quality marl. The clay core has also been extended to this depth. Interlocking steel piles have been used to cut off the wet dock.

On completion of tests for watertightness the barriers between the new channel and the canal were removed and traffic was diverted through the new cut to enable the now disused section to be sealed. This was done initially with tipped earth and later by interlocking steel piles. The materials excavated from the new channel were tipped and levelled into the bed of the old canal.

The cost of the two schemes including the purchase of land totalled approximately £90,000. Thurlwood Lock was designed by Mr. Muir White and the contractors for the steelwork were Sir William Arrol & Co. Ltd., Glasgow. The contractors for the Marston New Cut were George Dew and Co. Ltd., Oldham, and both works were carried out under the supervision of Mr. E. W. Ratcliffe, North Western Divisional Engineer, British Transport Waterways.

Cutting handling costs in Ports

Yale trucks cut loading and discharge times

In ports throughout the world, conventional methods of loading and discharging ships are being superseded by palletisation and industrial trucking. This has resulted in more tonnage per gang-hour; in less breakages; in quicker turn-round and bigger pay packets for dockers.

Handling eggs . . .

A new scheme embodying the use of pallets and Yale trucks is already showing economies to the North of Scotland, Orkney and Shetland Shipping Company.

By the end of this year over 80 million eggs from Orkney and Shetland will be handled on Leith quays by Yale Series 51 trucks; stowed in ships' holds by Yale Hydraulic hand lift trucks. Tonnage handled has risen from 7 to 20 tons per gang-hour, breakages have been considerably reduced, and dockers' earnings have gone up.

Yale Series 51 electric trucks are available in capacities from 3,000 lbs. to 10,000 lbs.

General cargoes . . .

Recent re-timings of shipping services between Harwich and the Hook of Holland cut available cargo handling time at Harwich by a third. The Dutch shipping company, Stoomvaart Maatschappij 'Zeeland', adopted trucks and pallets to ensure tonnages handled were not similarly reduced. Here, British Transport Commission men use Yale Worksaver pallet trucks to move cargo to the centre of the hatch for craning overboard.

Yale Worksavers are available in platform and pallet models (2 or 3 tons), Fork Lift (1,500, 2,000, 2,500, 3,000 lbs.), Tractor (700 lbs. draw-bar pull).

Crated cars . . .

Stowing crated cars on an uneven surface formed by irregular packs of tinplate became simpler, less laborious when Yale Hydraulic hand trucks were brought in to do the job.

Crates were craned through the hatch directly on to the trucks and moved into the wings in one movement. This method, used recently by Newport dockers during the loading of the M.V. Otaki, cut man-handling and completed the loading operation in 18 hours — a time considerably below that which could be expected with conventional methods.

Yale hand trucks are available in capacities up to 10,000 lbs.

The Yale range includes power trucks for every lifting need up to 200,000 lbs. Hand trucks for loads of up to 12,000 lbs. Hoists for lifting up to 40 tons (trolleys to suit all models). Pul-Lifts in capacities from ¾ to 15 tons.

THE YALE ADVISORY SERVICE. For free advice on your own handling problems write to

YALE
REGISTERED TRADE MARK

The world's largest range of materials handling equipment

The YALE & TOWNE Manufacturing Company,
Materials Handling Division, Dept. DH5, Wednesfield, Staffs. Tel: Willenhall 941

Marine Information Co-Ordinator (MIC)

By N. L. SPOTTISWOODE, of Gas Accumulator Co. (United Kingdom) Ltd., Brentford;
J. TEBBIT, of Pye Telecommunications, Ltd., Cambridge;
P. D. GIBBONS, of Stone-Chance, Ltd., Crawley.

IN order to make the best use of the facilities offered by V.H.F. Ship-to-Shore communication, the Port of London Authority has built an entirely new Communication Centre at Gravesend, which became operational on 1st May. From the Operations Room in this building it is possible to speak directly to any suitably equipped vessel in the area under the control of the Authority.

In planning the operation of the Communication Centre, the Authority early realised that in order to make best use of the ability to speak directly to vessels, it would be necessary to increase and speed up the flow of information into the Centre from shore-based sources.

One very vital type of information which may be requested by vessels is the exact Rise of Tide at various points in the river. Whilst Tide Prediction Tables are available, local conditions of wind and fresh water flow can cause errors in the predicted heights of as much as 2-ft. At present, the P.L.A. has a number of Tide Recorders at various points on the river, but these are normally visited only once a week for changing of charts, the charts being, in fact, mainly used for compiling the predictions for the following year. The Authority, therefore, approached a number of firms asking for proposals for equipment which could be attached to the existing Tide Recorders to enable the information to be conveyed to the Gravesend Centre by radio and recorded there on a similar chart.

The scheme which is described below was developed by the Gas Accumulator Co. (United Kingdom) Ltd. and the prototype unit is now undergoing field trials at Gravesend in collaboration with the Port of London Authority.

In designing a system of telemetering suitable for use with tides, the principal considerations, apart, of course, from the overriding one of reliability, are as follows:

(a) Minimum power consumption at remote sites, since there may sometimes not be mains power available.
(b) Use of the minimum number of radio channels.
(c) Flexibility. It should be possible to add extra sites without interrupting the equipment, which will normally be in continuous use. Nevertheless, the Authority who starts with a single tidal site does not want to purchase a lot of equipment which he will never use.

The first design factor which had to be settled was the type of code to be used. Broadly speaking, this could be either analogue or digital. Whilst the analogue method has attractions in that only a very short sampling time is needed, it is not generally suitable where high accuracy is required, particularly when used with a radio link. For the tidal information, an accuracy of about $\pm 0.25\%$ is generally required, corresponding, in the case of the Port of London Authority, to $1\frac{1}{2}$-in. in a total rise of 32-ft. For these reasons it was decided to use a digital code and the best compromise between simplicity of equipment and short sampling time indicated using the binary system. The rise of tide is translated into eight pulses, each of which can represent either 0 or 1, thus giving 256 possible combinations. The "0" and "1" pulses are distinguished by two different audio frequency tones.

Since it is intended that the whole system should work on one radio channel, it is necessary to be able to distinguish between signals from different sites. This could be done by allocating different pairs of audio frequencies to the different sites, but such a method adds considerable complications at the receiving end. It was, therefore, decided to add three more binary pulses at the beginning of each signal, thus providing for a maximum of eight sites.

Whilst discussions were going on between the Port of London Authority and the Gas Accumulator Co. (United Kingdom) Ltd., the former decided that it would be advantageous to make use of the Fog Detector recently developed by Stone-Chance Ltd., in order to measure the visibility at various points in the river where it is not possible to have manned reporting stations, and they request the Gas Accumulator Company to provide facilities for encoding, transmitting and decoding this information as well. A description of the Fog Detector is given later in the article, but for the moment it will suffice to say that the visibility is measured in terms of five steps, ranging from one mile or greater down to 250 yards or less. This information can thus be coded into three pulses.

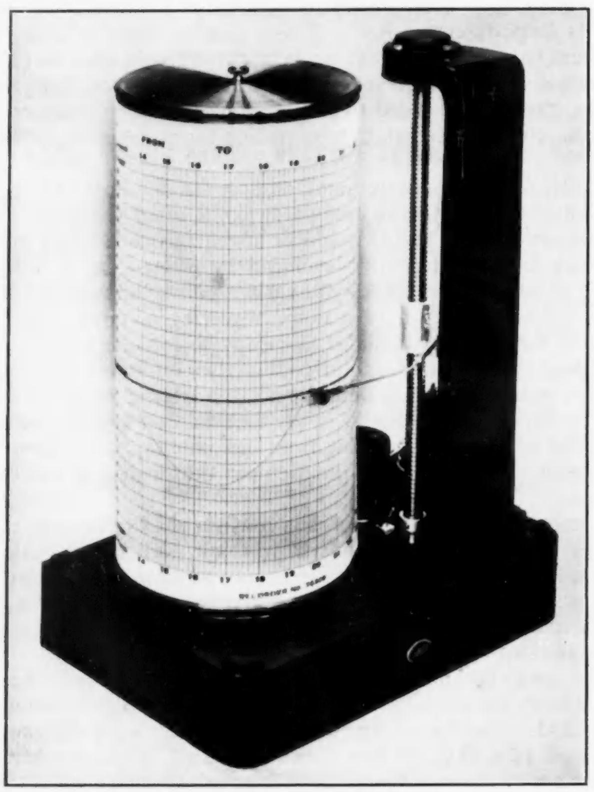
A complete train of signals thus consists of 14 pulses and takes rather less than three seconds to transmit. This time could be considerably reduced if there were any advantages in doing so. The system allows for the transmission from eight tidal sites and eight visibility sites, the sites being either combined or separate, as conditions require.

For the radio link, the G.P.O. recommended the use of the 450 Mc/s band, the equipment being supplied by Pye Telecommunications Ltd. The apparatus at the remote sites is all designed to work off 12-v. D.C., so that it can be run off batteries where no mains are available. Where there is a mains supply, this is transformed and rectified to 12-v. and a floating battery can be supplied to cover possible periods of mains failure.

As was mentioned earlier, it is desirable to reduce to a minimum the total time occupied by transmissions and this raises the question of how frequently information should be transmitted from each site. In the case of the tide, which varies in a regular, but not constant, way, it is sufficient to initiate a signal whenever the tide changes (up or down) by one unit. Since each signal comprises the complete information of tidal level, any error which may occur in a particular signal (due, for instance, to interference to the radio link) will be self-cancelling and not accumulated. Owing to the approximately sinusoidal form of the tide, the intervals between signals will vary from about 15 minutes at high and low water to about $1\frac{1}{4}$ minutes when the tide is running full. In the case of visibility, this will vary in an entirely unpredictable manner and may, for instance, remain constant for days on end. It is, therefore, desirable that a signal be sent at every change of visibility with an overall arrangement to send a signal each half hour when the visibility has not changed.

As previously stated, all the sites (up to a maximum of 16) transmit on the same radio channel and it is, therefore, necessary to ensure that no two of them come on the air at the same time. It is true that with only a small number of sites, the probability

of this happening is very small and arrangements at the receiving end are such that in the event of signals overlapping, no information (rather than wrong information) would be read out. Nevertheless, it was felt that with the full complement of sites, some arrangement must be made to prevent overlapping. One method would be to interrogate each site in turn from the receiving site. This, however, would require a receiver at each site, which would have to be running all the time. The method actually adopted also requires a receiver at each site, but this receiver is only switched on for short periods. The sequence of events when a signal is initiated at a site is as follows:



AGA Tide Recorder.

(1) The information (tidal and/or visibility) is stored.
(2) The receiver is switched on; if it detects a signal from one of the other sites, it holds off the H.T. supply to the transmitter.
(3) When the other signal ceases, the receiver switches on the transmitter and the coded signal is sent out.
(4) Transmitter and receiver are switched off until another signal is initiated by a further change in tide or visibility.

THE AGA TELEMETERING SYSTEM

The units comprising the AGA Telemetering System are as follows:

Tide Coder

This is either operated direct from a float and drum or else can be arranged to connect on to an existing Tide Recorder. The coding is performed by a printed circuit code disc, which also performs the signal initiation at each change of tide of 1 unit. Since, as previously explained, there may be an interval between the initiation of a signal and its transmission, provision is made in the coder for the code disc to be locked in position as soon as the signal is initiated. During the waiting period, any further movement of the tide float winds up a light spring, so as to avoid holding the float and thereby causing steps in the trace of the chart recorder to which the coder is coupled.

Control Unit

This contains two transistorised oscillators for generating the tones corresponding to the binary "0" and "1" and also the necessary relays for switching on the receiver and transmitter at the appropriate moment. A socket is provided into which a pre-wired plug is inserted, giving the appropriate site identification code.

Selective Amplifier

This is fed from the receiver at the Communication Centre and consists of two separate channels tuned to the "0" and "1" frequencies. The output consists of D.C. pulses suitable for operating the "0" and "1" relays.

AGA Dial Indicator.

Decoding Unit

This contains 14 remanent relays and a stepping switch. The pulses are fed into it and the signal is stored in the remanent relays, the two possible positions of which correspond to binary "0" and "1." At the end of the signal (provided that exactly 14 pulses have been received) the stored information is connected momentarily to the appropriate read-out socket, of which there are 16.

Failure Warning Unit

In the event of no signal being received from any one site for a period of half-an-hour, a bell rings and a light on the panel indicates which site has failed.

Tide Chart Recorder

The tide read-out is in the form of a chart recorder arranged to take the same charts as are used in the existing Tide Recorders.

Dial Indicator

Eight keys are provided on a panel which can be mounted at some convenient place. By depressing the appropriate key, the

Rise of Tide at any particular site is immediately indicated on a 12-in. wall-mounting dial.

All the units, apart from those actually presenting information, are built on standard 19-in. panels, which are mounted in a cubicle in the Control Room. The remaining units are housed in the Operations Room.

STONE-CHANCE VISIBILITY DETECTOR TYPE FD3

Stone-Chance Limited introduced a fog detecting unit in 1957 (based on research carried out by the Research Department of Trinity House), which was first displayed at the A.S.E.E. Exhibition that year winning the First Industrial Award. This unit is a fairly complex piece of mechanism and is primarily intended for lighthouse duty where relatively high accuracy is required. A specially designed version of this apparatus, in simplified form, for river estuaries and like purposes, is shown. The basic principle of operation is as follows:

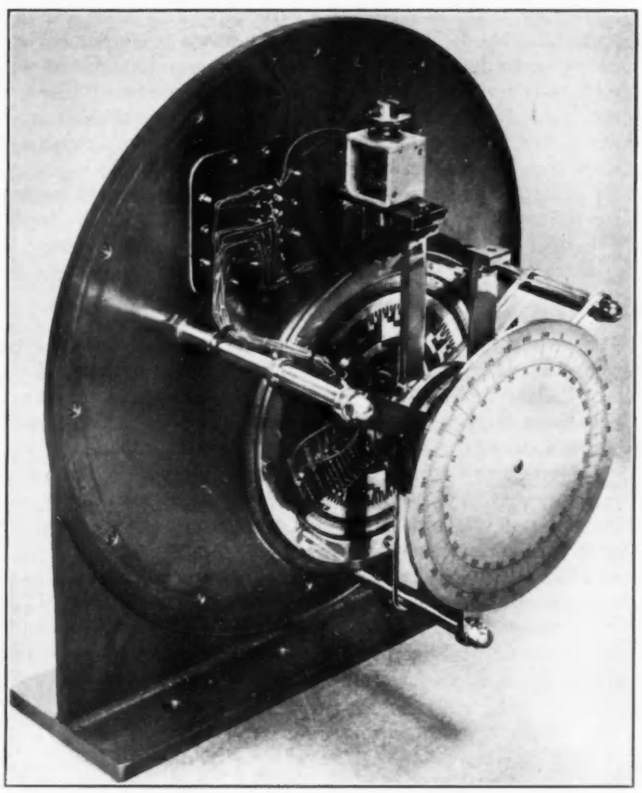
A special lamp is flashed by means of a code unit and emits very short intense pulses of light, a drum lens is used to produce a beam of light in the horizontal plane. Some distance below the light source and its lens a second lens and photocell or receiver unit is arranged so that its field of view is inclined upwards and intersects the beam of light over a range of approximately 150-ft. Any light scattered by particles or droplets of water in the atmosphere which lie in the field of view of the reservoir unit will be converted into an electrical signal.

Mounted adjacent to the receiver unit is an amplifier which amplifies the electrical signals and passes these to a " gate " circuit; this gate is normally closed and blocks the passage of the signals to the remaining parts of the circuit. When the lamp is flashed, however, the code unit at the same instant that it causes the lamp to flash sends a control pulse which opens the gate momentarily and allows the signals to pass from the amplifier circuit to the detector circuits. It will, therefore be seen that the detector circuits only receive signals which are received by the photocell while the lamp is emitting light.

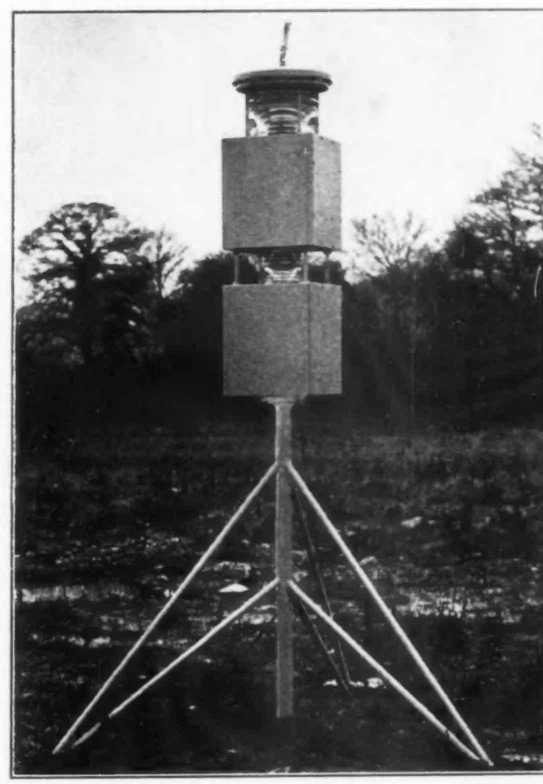
It can be shown that the signal received by the receiver unit due to scattering from particles in the light beam is inversely proportional to the visible range, within limits dependent upon the mechanical arrangement of the system.

The detector circuits control the position of a selector switch which takes up one of five available positions according to the prevailing visibility:

(a) Over one mile; (b) $\frac{1}{2}$ to 1 mile; (c) $\frac{1}{4}$ to $\frac{1}{2}$ mile; (d) $\frac{1}{8}$ to $\frac{1}{4}$ mile; (e) Less than $\frac{1}{8}$ mile.



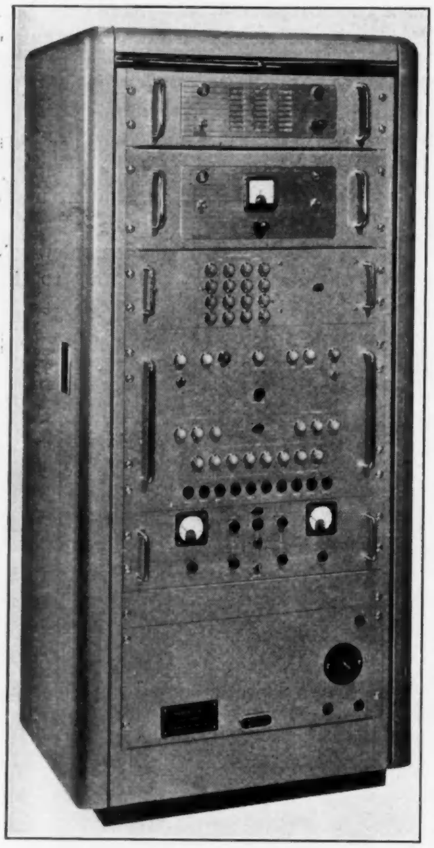
AGA Tide Recorder.



Stone-Chance Visibility Detector Unit Type F.D.3.

The selector has banks wired to give digital information which is passed to the coder unit for transmission to the Communication Centre. The detector has contacts built in to initiate the transmission of information whenever the visibility changes or, if a change does not occur within thirty minutes, then a timer causes initiation at the end of this period. A monitor circuit is also incorporated to transmit a fault code should the detector fail.

The complete unit is of column form and about 3-ft. 6-in. high. It can be mounted on a suitable stand or pole at the desired measuring site. The circuits operate from an external 12-v. D.C. battery, which means that in remote places a mains supply is not necessarily required. The light emitted by the unit as it flashes is very characteristic and bright and although the apparatus is not necessarily intended for navigational purposes the light can be seen in clear weather for several miles.



Cubicle containing Pye Radio, AGA Decoder and Stone-Chance Memory Unit.

The mechanical arrangement of the unit is such that it only samples the volume of air in the immediate vicinity and, therefore reflections from obstructions, such as buildings, ships, etc., beyond the sampling range have no effect. The information provided by the unit is therefore, based on the conditions prevailing in the immediate vicinity of the site. A number of units must be placed at strategic points to obtain an overall picture of visibility. Normally the units are designed for 360° operation, but can be arranged to operate over a restricted arc if required.

At the Communication Centre at Gravesend the decoded digital information is passed from the decoding unit into a memory and read-out panel which can memorise the information from up to eight detectors and supplies outputs for the indicator lamps and recorders.

PYE U.H.F. TRANSMITTER/RECEIVER UNIT

The Pye P.T.C. 8710 U.H.F. Fixed Station has been designed to provide reliable communication in the 450-470 Mc/s frequency band. It can be supplied for single or double frequency simplex or duplex working with channel spacings of 50-60 kc/s.

Although intended for operation in point-to-point links, this equipment embodies features which may be suitable for many other applications where absolute reliability is of the utmost importance. Both the transmitter and receiver are fitted with temperature controlled crystal units ensuring exceedingly high frequency stability over a wide ambient temperature range.

The standard equipment is normally supplied for A.C. mains operation, the power unit being adjustable to most supply voltages between 100-250-v., 50 c/s A.C.; when required a separate D.C. power unit is available for operation off 12-v. accumulators. The transmitter and receiver are mounted on separate chassis and are normally supplied fitted in a robust cabinet of pleasing modern design. If required, both units are available in chassis form suitable for installation in 19-in. racks. The material used throughout has been chosen to ensure reliable operation over a wide range of climatic conditions.

Additional control apparatus is available which enables the equipment to be operated from another part of the same building over a distance not exceeding 200-ft. Remote control facilities utilizing telephone lines could be supplied for use when greater distances are involved. The maximum distance is determined by the loop resistance, which must not exceed 3,000 ohms. The Switchboard Termination Unit is also available so that the Station can work into a manual or automatic telephone switchboard when used as a point-to-point telephone link.

The Dredger "Sir Crawford"

Varied Duties in British Guiana

By R. S. MORTIMER

On the whole, the dredger is a somewhat unspectacular vessel and seldom enjoys the prominence which its ranking as one of the principal units in a port and harbour system deserves. There should, however, be no uncertainty regarding the important work done by a dredger in port development, maintenance of water depths, safe navigation and the timely movement of ships. In addition to those responsible for this work, the shipowner, the mariner, the wharfowner and, nowadays, even the scientist are all concerned in the activities and scope of a dredger.

To illustrate the many tasks that such a vessel can perform, there follows a practical description of one particular dredger, the work it carries out and the additional tasks it undertakes in the interests of a country and its shipping.

The Vessel

The twin screw steam grab dredger "Sir Crawford," with a designed speed of 9 knots, was built in 1935 by Fleming & Ferguson of Paisley for the Government of British Guiana. The vessel, which has a hopper capacity of 500 tons, has a length of 150-ft., a breadth of 32-ft., a depth of 12.5-ft., with a loaded draft of 9.5-ft. It is fitted with a Priestman No. 60 size dredging crane with a capacity of 3 cubic yards, the depth of working is 50-ft. below water level, and the appliance operates with a total load of grab and contents of 6.5 tons.

In 1956 the "Sir Crawford" was reconditioned by Sprostons of Georgetown, who also installed two new boilers in 1957. Following this work there was a change in the original profile of the vessel, as a new navigating bridge was built, and a substantial pile driving rig erected on the starboard side adjacent to the boat deck.

The vessel has a crew of 15, who are wholly Guianese.

Main Duties

The "Sir Crawford" is principally engaged in dredging the main and secondary wharves in the harbours of Georgetown and New Amsterdam, where the material to be dredged is soft mud from the mud and clay formation which underlies the entire coastal region and tidal estuaries.

This formation extends northwestward to connect with the muds of the Orinoco river, and to the eastward it forms the coast plain of Dutch Guiana and finally disperses at the boundaries of French Guiana. It is considered that the formation was originally derived from sediments brought down by the rivers of the Guianas, and the fine mud from the deep layer of soft mud above the hard stratum is continually being brought into suspension by wave and tidal action which give the coastal and estuarine waters a muddied appearance.

It is the work of the "Sir Crawford," therefore, to maintain satisfactory depths at the wharves used by ocean-going vessels under the acute silting conditions which result from the continuous movement and deposition of sediments in these harbours. This work essentially requires a very handy dredging

vessel, particularly as the main wharves are privately owned and are generally occupied either by ocean and coastal vessels or barges, and any closing of a berth for dredging purposes means a delay to ships and a loss to the individual wharf owner.

That the "Sir Crawford" is able to provide this condition reasonably well is due to her good design and manoeuvrability, the reliability and speed of her dredging appliance, and the close co-operation of all concerned. It is only by these means that satisfactory alongside depths can be maintained, because any dredging programme must necessarily be flexible in places where private wharf owners can rarely accommodate a dredger as previously planned.

A further difficulty, particularly with regard to time and operating costs, is the long haul of 12 miles to the sea dumping ground with the dredged material. In this connection, with the low-lying coastlands of British Guiana the silt could be usefully employed for building-up and reclaiming purposes both at Georgetown and New Amsterdam, yet for years the "Sir Crawford" has carried out uneconomic dumping because the need to provide the necessary installation to accept and return the silt to the land has not been properly recognised.

Certain other areas are also dredged annually by the "Sir Crawford." These include the river approach channel, the turning basin and the wharf at the bauxite loading terminal at Mackenzie some 60 miles upriver from Georgetown where the material to be dredged is hard and mainly composed of sand and bauxite.

The entrances to the two small dry docks and numerous drainage run-outs are also attended to as required, and there is a minor sugar estate wharf where the "Sir Crawford" must dredge a mixture of mud and sugar cane in order to clear the berth. The cane causes excessive siltation and is inclined to slow up the work and block the hopper doors when dumping. It is of interest that the dredging crane is used to lift the gates of one of the small dry docks for annual inspection and overhaul.

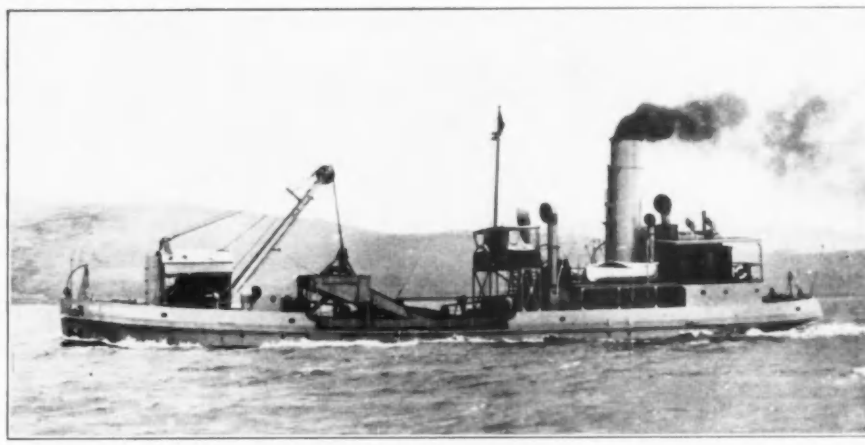
Buoyage

In order to construct and maintain efficiently the offshore and river fixed and floating aids to navigation in British Guiana, it is necessary to have a suitable vessel for this work.

Generally speaking, to convert a vessel for specialised duties is seldom successful, as there are certain inherent factors which impose limitations in the extent to which effective conversion can be carried out. However, the limited resources of British Guiana and the volume of visiting shipping cannot support a specially built buoyage tender which would be capable of performing all the supplementary duties undertaken by the "Sir Crawford," of which pile driving is an important one.

With regard to this, particularly for the secondary ports with small revenues and similar local features, it is considered that there is a very good case for designing a satisfactory general purpose dredging vessel which would give superior performance to the "Sir Crawford" as improvised and modified locally for supplementary duties.

It is desirable to remark here that the only colony-owned vessel suitable for buoyage work is the "Sir Crawford," which can, with reasonable safety and efficiency, assume these duties additional to dredging. Although not designed for this purpose, the "Sir Crawford" is of heavy construction, has adequate seaworthiness for any prevailing weather conditions off the coast, a heavy lift crane, good manoeuvrability, and a low freeboard deck to assist men to handle the buoys and appendages safely and conveniently. Naturally, seamanship and a specialised technique play an important part in the safe and efficient handling of the seabuoys when using the dredger, and the buoy laying and recovery operations are only speedily and safely accomplished, especially in the more difficult sea and swell conditions, by combining good seamanship with the handling and towing of the buoys within the dredger's build and equipment. The crane and pile driving rig only are used to connect, break, and recover the moorings and sinkers. Here it should be noted that, whether using a specially designed buoyage tender or a vessel modified for this purpose, the seamanship must always be of the highest order to avoid injury and damage.



The Dredger "Sir Crawford."

For the buoyage operations the "Sir Crawford" has the additional space to carry a team of riggers and the necessary gear and spare moorings. Occasionally, the dredger may also carry a greenheart pile on deck and attendant carpenters in order to plant and establish a single pile light beacon with daymarks at some stage during a buoyage operation. Alternatively the vessel may be used in the rivers to check marker positions and water depths, to accommodate men engaged in clearing bush from leading marks, and to erect pre-fabricated structures on rock foundations for marine lights.

Pile Driving

Mention has already been made of pile driving, and the dredger has a permanent gantry rig and hoisting winch arranged on the starboard side to handle greenheart piling, normally 70 to 75-ft. in length. The gantry is known as "the monkey," and is extremely efficient in operation and a most useful unit for a port and harbour authority to possess.

The "Sir Crawford" can carry a number of piles on the hopper deck and, when suitably moored with a bow and kedge anchors at the working site, a pile is placed overside by the dredging crane, transferred to the gantry, and the driving is done by a hammer connected to the deck steam line.

The boat deck is stiffened and provides a good working platform and clear view for the men engaged in handling and driving the piles, and there is ample space for the stowage of their gear and tools.

By these means, wharf facing and fender piles are extracted and replaced, cluster mooring piles laid down, and single and multiple pile structures are built to carry marine lights, tide indicators and daymarks. The "Sir Crawford" built the 9-pile Demerara light tower some 6 miles offshore, the 50-ft. steel lattice structure being hoisted in place by using the dredging crane and the gantry. It will be appreciated that such structures can

be speedily repaired or replaced by the dredger if damaged by impact.

Towage

Apart from some heavily built diesel launches, the Colony harbour authority does not maintain a tug suitable for general towage work, and the dredger carries out these services as required. It therefore assumes the side towing of small coastal vessels, schooners, barges and cargo punts, either to clear a berth for other vessels or to clear a berth for dredging. When a punt sinks and fouls a wharf which is urgently needed, a towing line is attached by a diver and the dredger skids the submerged punt along the mud bottom to a point where it can be conveniently recovered.

The builders of local fishing and river vessels often request the services of the "Sir Crawford" to launch their craft from the foreshore when built, the kedge winch usually being used for the purpose.

On occasions, the dredger is used to assist and straight tow much larger vessels, and in the past has towed and relieved the former lightvessel on station when it was withdrawn for periodic overhaul. It may be employed in the future to tow a mud plough in the Georgetown approach channel and along the frontage of the main wharves.

Salvage

The "Sir Crawford" is a very useful vessel for salvage work in a colony which must depend entirely on improvisation and local methods in order to raise and recover craft and property. These methods are not always successful, as the shortage of proper equipment and the mud sinkage present difficult problems.

The dredger is, however, equipped with a heavy crane and is of strong construction, and much valuable property has been recovered which otherwise would have been lost. For example, a steel barge foundered off the coast with new pile driving equipment on board, including a steam boiler and winch, and the "Sir Crawford" was manoeuvred and moored close to the wreck and all the equipment was safely recovered by the dredging crane. Heavy greenheart squares from cargo craft and timber rafts have been recovered by using the grab appliance, which is also used to remove sunken piles obstructing a fairway or a wharf.

Surveying

In many ways the "Sir Crawford" assists the hydrographic surveyors, a particular service being to establish the fixed off-shore and river survey marks, and some years ago the vessel was used for the survey of the Georgetown outer approaches.

It is interesting to consider that though in the case of the "Sir Crawford" it has been necessary, in order to carry out the many duties required, to make certain structural alterations and additions since building, any new grab dredger could well have these features incorporated in her original design.

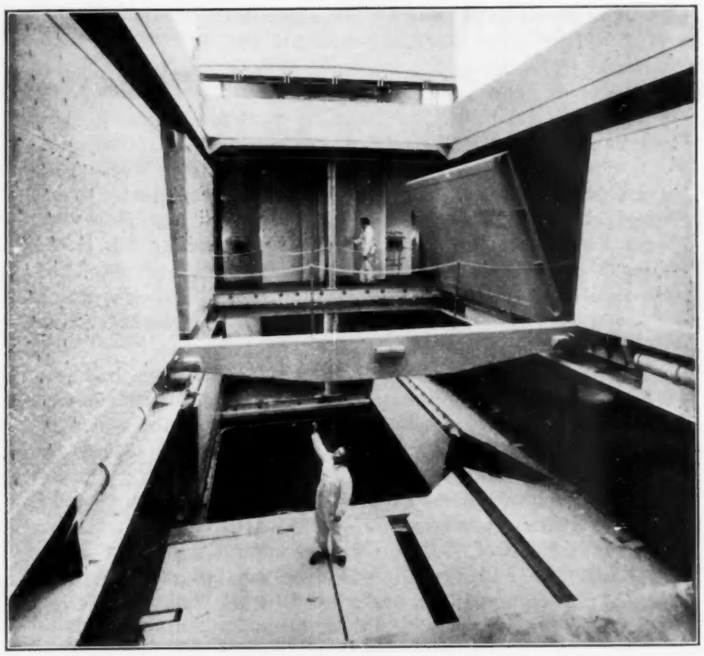
New Hydraulically Operated Steel Hatch Covers

For a number of years considerable attention has been devoted to the design and construction of cargo hatch covers on ships. With the advances in mechanisation, it has been made possible to reduce the time necessary to open and close a ship's hatches to a fraction of that previously required. An important step forward in this development has recently been announced by Aktiebolaget Götaverken of Sweden, who have installed hydraulically operated hatch covers of an entirely new type on the Norwegian cargo liner M.S. "Gudrun Bakke" 10,500 d.w.t.

The hatch covers are in the form of "pontoons," being completely covered with steel plates on both sides. When closed, they are flush with the deck, so that fork-lift trucks may be driven over them without being obstructed. The main feature of the equipment is the hydraulic arrangements for opening and closing. The difficulty has been to develop a hydraulic system which would be sufficiently strong and reliable without taking valuable cubic capacity or hindering the handling of cargo in the holds. After extensive research this was overcome, by the development of a new hydraulic screw-jack, which is of simple and robust construction and comprises only four working parts, i.e., a shaft and two pistons contained in a cylindrical housing. The entire movement takes place within the oil-filled cylindrical housing, and each jack has two working cylinders connected to a piping system branched to several hatches. The pressure is regulated from a control panel which can govern several hatches and can be directed to either of the cylinders according to whether the hatch is to be opened or closed. Close to the screw-jack, there is a check valve for compensating the weight of the hatch cover, which also eliminates the risk of accidents in the event of fracture of a pipe line.

M.S. "Gudrun Bakke" has seven weather-deck and fifteen lower-deck hatch openings. These are fitted with 22 covers made up of 76 sections. Sixty-two of these are operated by 45 hydraulic screw-jacks of the new type and the remaining 14 by telescopic jacks of the lever type.

The hydraulic screw-jacks impart a torque of 20 ft. tons at a maximum oil pressure of 1,400 lbs. per sq. in. and allow 90° angle of rotation. They are also available with torques of up to

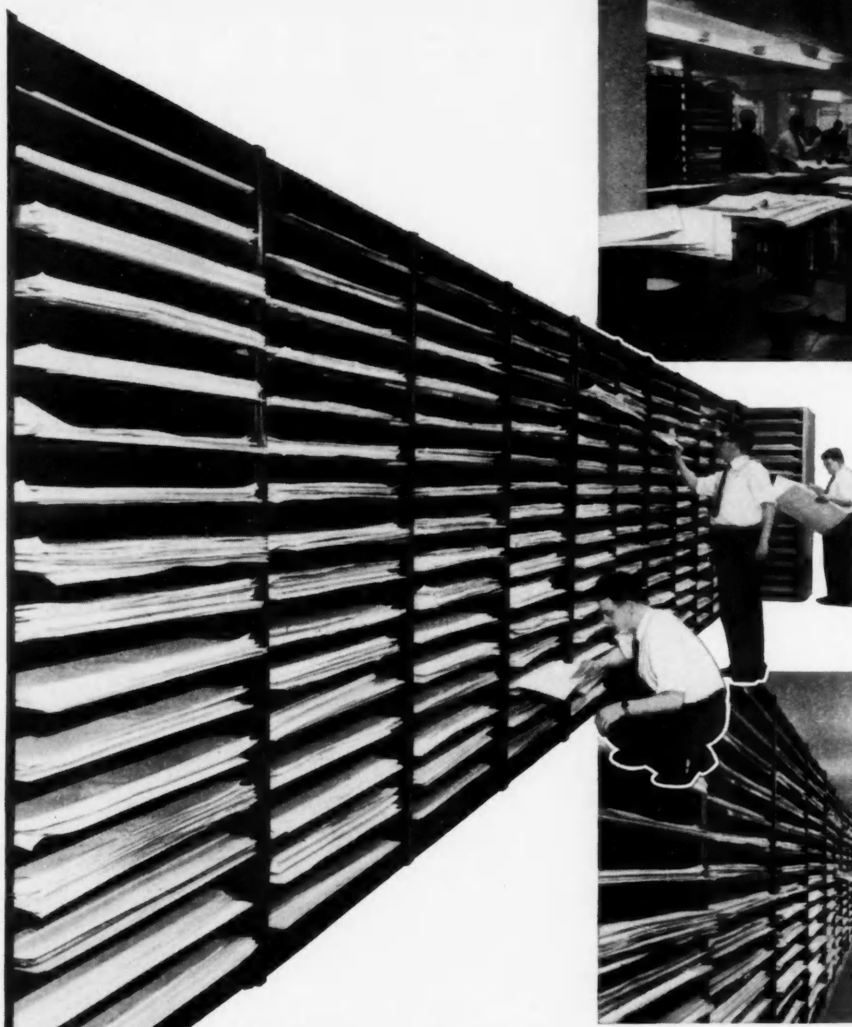


View of the new hatch cover.

100 ft. tons operating through an angle of either 99° or 180°.

During operation the hatch can be stopped in any position and once at rest no locking arrangements are required. The pumps are arranged so as to operate either independently or as stand-by for one another, and are designed to open or close a hatch within 45—60 seconds.

These hydraulic covers are claimed to be simple to install and can advantageously be used on both new and old ships. The only work required on board, with the exception of the installation of the oil-pressure system, is to connect the hinges and to arrange runways for the wheels and facings for the gaskets.



The new Kelvin Hughes Chart Department, where some 50,000 charts are filed and kept up to date

KEEPING 50,000 CHARTS UP TO DATE *at Saint Clare House**

Now housed in new premises at St. Clare House, Minories, London, E.C.3, the Kelvin Hughes Chart Correction Service has been re-organised for even greater efficiency. Here, continuous correction is made to a normal stock of 50,000 charts covering every port and trade route in the world. Single charts or world outfits to special folio requirements can be supplied from stock at short notice. The service covers collection of chart outfits at regular intervals and their return to the ship fully corrected and up to date.

*** The new premises of Kelvin Hughes include a well-equipped showroom where the most modern types of marine radar, echo sounders and general navigational instruments are on display in working order.**

KH

KELVIN HUGHES

THE TWO GREATEST NAMES IN NAVIGATION

KELVIN & HUGHES (MARINE) LIMITED

St. Clare House, Minories, London, EC3

TGA KHM108

Sixth Conference on Coastal Engineering

Review of Proceedings

By R. R. MINIKIN

In September, 1950, the first conference of engineers and scientists concerned with Hydro-meteorological physics took place at Long Beach, California, under the aegis of the University of California. The inspiring motive was the recognition during war time of the alarming scarcity of authoritative technical data pertaining to the natural phenomena affecting coastal lands, sea and wind.

American professors and engineers therefore felt the necessity to gather all the information of war time activities and investigations instituted by war requirements. The prime sponsors were the Council on Wave Research and the University of California, supported by the Corps of Engineers and the U.S. Weather Bureau.

Professor J. W. Johnson of California University (Hydraulics), then and since, took the lead in the onerous task of organising, launching and editing the proceedings of this new association. Thus the originating stimulus was almost entirely American, nevertheless it was soon evident, from the interest taken by foreign engineers and scientists, that the initial base would have to be widened to international status, which at the present time it undoubtedly is, under the title of "Coastal Engineering": a world wide association for the scientific collection and dissemination of knowledge of marine physics.

Six well supported conferences have been held already, the sixth and last in December, 1957, at Miami, Florida. These meetings have produced an extensive amount and variety of marine matters collated in large volumes of Proceedings of which No. 6 is the most recent. The volume itself is a weighty unhandy book, 7-in. by 10-in. by 2½-in. thick, containing 900 pages of text and illustrations. It is on good paper, each page being a lithographed copy of the author's original typewritten manuscript and drawings. The weight of the volume is over 4 lbs., which is rather heavy to hold and read with comfort: for the future smaller size volumes would be of advantage.

The subject matter of the present volume is divided into four parts as follows:—

Part I. Wind, Waves and Wind Tides.
Part II. Coastal Sediment Problems.
Part III. Coastal Engineering Problems.
Part IV. Coastal Structures and related Problems.

Each part comprises groups of separate papers or chapters dealing with various aspects of marine physics and the methods used to combat the damaging effects to man's property. Each chapter is contributed by one or more collaborating authors, complete in itself and in a specialist form which helps in the compilation of the basic knowledge of the physical processes observed in the reciprocal action between the three elements of land, sea and air.

The contributions are of high technical standard, competency, research acumen and experience, showing for the greater part an earnest probing of the problems dealt with.

Part 1. Wind, Waves and Wind Tides

There are sixteen papers in this section of which the following have been selected as they contain the most accurate and latest information available on hurricanes. It is only within the last decade that scientists have intensified their studies and had the resources to undertake investigations with instruments. Even now very little is known about the genesis of hurricanes. There are other papers on breaking waves, wave heights, tide problems and surge.

The first Chapter is a paper on "Winds and Pressures in Hurricanes" by C. S. Gilman and V. A. Myers, U.S. Weather Bureau.

The authors deal succinctly with the subject, pointing out that the key to hurricane energy is the vertical distribution of air density, which in turn, is related to the temperature and moisture content. For example based on the atmospheric soundings at Miami, and the air density-height curve, it is reasonable to assume that in the West Indian tropics every layer of air has a smaller density than the one immediately below it and is therefore in flotation; in addition, rising air encounters progressively lower pressure and therefore cools adiabatically; saturated air has a different rate of cooling to that of unsaturated air which has a standard rate. Thus if a large layer of air near the ocean surface were to rise upwards through the surrounding air until at some height (3,000-ft.) it becomes less dense than its environment it will then continue to rise spontaneously to great heights up to say, 40,000-ft.

Once this great chimney of convection (maybe 50 to 100 miles in diameter) has been established a hurricane will maintain its vigour so long as it can feed on air of the proper vertical density distribution. The air is drawn in from a large surrounding area of sea surface which may extend to some hundreds of miles in diameter. This is usually illustrated by a diagram showing a narrow annular figure representing one hour inflow into the chimney placed eccentrically in a much larger figure of lozenge shape representing 24 hours inflow: further to this a yet larger lozenge shape encloses the above and represents another longer period inflow area. They only come into existence over ocean areas at seasons of strong insolation and warm water temperature in essentially homogeneous warm moist air with no fronts, or temperature and moisture discontinuities.

If relatively dry air is drawn into the hurricane eye the storm must weaken. If it moves over land it will lose energy and diminish. Rainfall is an inherent and necessary part of all hurricanes, in fact, heavy rainfall may presage two or three days in advance the coming of a hurricane.

The extreme minimum pressure so far recorded in the vicinity of the U.S.A. was 892mb (26.35-in.) in the Florida Keys (1935) hurricane. Winds 75 m.p.h. and above are termed hurricane winds. Care must be taken to distinguish between sustained and gusty wind; for engineering purposes the relation one to the other is as 2 to 3 approximately.

Another lucid paper is given on "Hurricanes and Hurricane Tides" by G. E. Dunn, U.S. Weather Bureau, Miami. The Author gives a few further details and brings the picture up-to-date on what is actually known.

He points out that the Atlantic hurricane closely resembles the Pacific typhoon, and the tropical cyclone of the Indian and South Pacific Oceans. It is a storm of tropical origin with cyclonic wind circulation, counterclockwise in the northern hemisphere and winds of plus 75 m.p.h. The exact nature of the physical processes in the formation is not definitely known. There is one meteorological feature that appears to be essential: and that is, a wind flow in the high troposphere which will permit the ready removal of the excess air and heat to other regions outside of the hurricane area.

The energy for the growth of an ordinary disturbance into a hurricane arises from the release of energy in the form of latent heat of condensation during the precipitation process.

After a few days development the intensity of a hurricane may be relatively small: that of Florida Keys (1935) with a central pressure of 892 mb. is the most intense recorded and yet it was only 35 to 40 miles wide whereas several Atlantic hurricanes have been up to 500 miles wide with full hurricane winds of up to 300 miles wide. The average diameter of hurricane winds ranges between 75 to 100 miles.

Tropical storms have averaged only 8 per year over the last 75 years, the highest number was 21 in 1933 and the lowest

1 only in 1914. A point of note is that in Florida out of 74 hurricane storms, over the greater part of a century, 31 are known to have caused damaging tides. It has been computed that a 6-ft. storm tide occurs somewhere in Florida at least once every two years. The average life span of a hurricane is about 9 days, those of late summer usually last the longer, up to 12 days.

The curious track and long life of the hurricane "Carrie" in 1957 are interesting and instructive. It was first of all picked up near Cape Verde Islands on 2nd September moving westerly with slight north bias until on the ninth day it made a near right angled turn to almost dead north for four more days when the course changed to left incline in north west direction, arriving three days later a few score miles north of Bermuda. Here it circled the Island and then took a direction due east almost on the 35th parallel for five days further; then following a direction east north east it cut across the Azores Islands towards the British Isles.

In all the recorded path for 21 days was closely observed until it finished up outside of the tropics over Britain.

The wave heights are dependent upon the velocity of the wind, fetch and duration of the wind in a straight path. The highest winds are in the right semi-circle of the vortex about the centre and generate the highest waves which, moving faster than the storm may reach a coast line several hundreds of miles ahead of the eye of the hurricane. The highest storm surges on the coast are occasioned by the hurricane storms of relatively smaller wind eyes; and the larger they are the less severe are the effects.

From accumulated data it appears that the height of a storm surge tends to be greater in regions in which the continental shelf is flattest, although there is no evidence that the variability of the peak storm surge height may be due to the variations of the intensity of the storm itself.

On the flooded coasts the most damaging factors are the short period waves and swell which may be prominent along the coast several hundred miles from the storm.

Professor B. W. Wilson in his lengthy paper on "Hurricane wave statistics for the Gulf of Mexico" produces a highly informative and valuable analysis of the available records of this century. Tables and diagrams compiled from the analysis assist in establishing polar diagrams, and the Frequency of Occurrence of hurricane waves, significant height, and period for particular localities. For example, the chance of a 35-ft. high deep water wave from the south is one in 100 years but from the south-south-east one in twenty years; once in five years significant wave heights will reach 30-ft. and once in 2 years waves of 19-ft.

D. L. Harris, U.S. Weather Bureau, Washington, states that the land fall of a hurricane is generally accompanied by an increase in the tide level of 4 to 15-ft. above the normal value some hours before the storm arrives but as soon as the gale winds reach the shore a rapid rise of tide takes place. The peak rise usually occurring within an hour or two of the arrival and the maximum surge and highest high water mostly to the right of the centre line of the storm track.

Short period wind, waves and swell add greatly to the damage caused by flooding of storm tides. They also add to the difficulties of obtaining reliable or reasonably accurate information of the height of the actual tides. This is understandable when it is recalled that the observed tide is a summation of the predicted tide and the meteorological tide or surge, and for the difference in phase.

Part II. Coastal Sediment Problems

This section comprised eight excellent papers, submitted by unquestioned experts, and was mainly concerned with the vagaries of the transient beaches. However, there is one paper, chapter 17, which although well written shows a profound ignorance of the sea and beaches.

Professor J. A. Steers, Cambridge, England, in his paper "How are Beaches supplied with Shingle?" demonstrates with his accustomed acumen and orderliness the difficulties of tracking shingle movements on the foreshore even with the extensive use of radio active shingle. He opens with the trite remark "it is now generally assumed, but by no means always proved, that shingle on beaches is moved almost exclusively by wave action." He then goes on to explain that observations of many beaches show a great diversity of movement of the transported material. Complications abound—that it is unwise to attempt generalisations excepting locally where the morphology looms into its full importance and currents if not known have to be traced. To illustrate his argument of the tantalising nature of the factors he cites as an example the huge accumulation of shingle forming Dungeness headland, "... but no clear answer has yet been given about how the shingle of Dungeness crosses Rye Bay, which, presumably it must do."

Again he is in a state of wonderment as to the origin of the vast accumulation of shingle at Orford Ness. The historical data goes back for centuries and shows the regular growth—surely the rounded pebbles supply the answer.

He further expresses doubts about the travel of shingle along the coast, even at the mouth of the Wash, a district known by him intimately for decades where there is a substantial accumulation. He is plainly averse to shingle crossing any deep water channel and seeks to explain how the shingle which lies there on the beach . . . got there.

To this end in 1956, 1,200 shingle pebbles were rendered radio-active and dumped in 16 to 20-ft. of tidal water distant 500 yards off Scolt Head Island. The seabed was hard, of sand and some shingle. In the period of about 40 days during which the tracers were tracked with detecting instruments the weather was normal, containing several squally days but no prolonged storms. It was found that some of the pebbles had moved shorewards, some to the south and others about 260-ft. to the north.

A further 2,600 radio-active pebbles were used on a more southerly portion of this coast which gave more definite results showing that a limiting local influence confined the tracers to a general common direction of drift.

During the period of the test the winds did not exceed Force 3 and wave heights not more than 2-ft. Steers quotes Kidson as saying . . . "Waves approaching from a northerly quarter, combining with the tidal current (which at Springs may reach a velocity of 7—8 knots on the ebb) in the entrance of the river Ore can move shingle from the north Weir Point across to the opposite bank . . . It is probable that the pebbles which reached the beach at Shingle Street had all arrived there by way of the off-shore banks."

The conclusion is reached that many beaches are fed from off-shore especially in places where there is good reason to suppose that glaciation has left plenty of mud, sand and stones on the sea-bed. Conviction is not enough; it remains to be proved that it does so in many and diverse places.

"The Use of radio-active tracers for the Study of Sand on the sea-bed" is the title of an informative paper compiled by J. Germain, G. Forest and P. Jaffry of the French National Hydraulics Laboratory, Paris, in which they discuss the design and methods of using instruments. They also give some results of the practical application in tracing the sand movements in the Estuary of the river Adour on the Bay of Biscay. This is a most helpful paper as it gives authoritative information on salient features and successful methods of selecting a correct apparatus for tracing and detection of the radio-active particles under water. It cannot be claimed that the results are reliable, nevertheless they have shown that they are possible and eventually, no doubt, the difficulties will be surmounted.

Litigation in the Port Industry

Liability Under Bill of Lading

An important case was concluded in the Queen's Bench Division (Commercial Court) in London on 28th April, 1959, when Mr. Justice Diplock gave reserved judgment in an action in which Midland Silicones, Ltd., of Barry, Glamorgan, were awarded £593 12s. 2d. damages, with interest and costs against Scruttons, Ltd., of Colonial House, Mincing Lane, E.C., being the value of a drum of chemicals dropped by the negligence of defendants' servants.

Defendants admitted liability for the damage to the drum, but claimed that it was limited to $500.

When giving judgment, Mr. Justice Diplock emphasised that the action was a test case, brought to determine whether stevedores engaged by a shipowner or a carrier, who, in performing their function as stevedores in landing, loading or unloading cargo, tortiously damage the cargo, can, in an action brought against them in tort by the cargo owner, rely on any immunity from or limitation of liability contained in a contract between the cargo owner and the shipowner or carrier.

This question had been much debated in the past 25 years, but had never been authoritatively decided in this country. In Australia, it had been decided in 1956 in the negative. In the United States of America, after considerable litigation with varying results it had been authoritatively decided in the same sense by the Supreme Court only a week before this present action.

The cargo in question had been shipped by the consignors on a ship owned by the United States Lines Company to London. After the bill of lading had been forwarded to plaintiffs, plaintiffs became and were the owners of the drum. For some years past, the United States Lines Company had engaged defendants to discharge their vessels into London and act as their agents in delivering the goods to the consignees.

This arrangement was under a contract dated 1932 which stated expressly that the stevedores were to be responsible for any loss of or damage to goods caused by the negligence of themselves or servants.

The drums of chemicals was stored temporarily in a shed leased by the United States Lines Company from the Port of London Authority. After customs' clearance, plaintiffs applied to Messrs. Scruttons for delivery and it was while the drum was being loaded on to a lorry for delivery that it was dropped and damaged.

This act of lowering the drum on to the lorry, which was negligently performed by defendants' servants, was (1) an act which fell within the scope of defendants' servants employment by defendants (2) an act which, by the terms of their contract with the United States Lines Company defendants had contracted to do and (3) an act which, by the terms of the bill of lading, the United States Lines Company had contracted with defendants to do.

It was for defendants to show some principle of law under which they could limit their liability to plaintiffs to $500 or its sterling equivalent.

Clause one of the bill of lading governed the relations between the shipper, the owner and carrier, master and ship in every contingency and whensoever occurring. There was no mention of stevedores.

By the clause paramount, the provisions of the American Carriage of Goods By Sea Act were incorporated and it was expressly provided that such provisions should govern both before the goods were loaded and after discharge and throughout the entire time the goods were in the custody of the carrier. Section 4 (v) of the American Act provided that neither the shipper nor carrier would be liable for any loss of or damage to goods in transit for an amount exceeding $500.

The American Act contained no definition of "carrier," but provided that it should include "the owner or charterer who enters into a contract carriage with the shipper."

His Lordship said the bill of lading provided that the word "carrier" should include the ship, her owner, the demised charterer and also any time-charterer or person bound by the bill of lading. It did not include stevedores.

His Lordship was of opinion that the bill of lading did not purport to govern the relationship between the shipper and the consignee or any stevedores engaged by the carriers.

"Thus, the limitation of liability which defendants seek is only contained in a contract which they did not execute and which does not expressly purport to have been made for their benefit," said the Judge.

One therefore had to start with two principles of law. First, only a person who is a party to a contract can sue on it and secondly, if a person with whom a contract has been made is to be able to enforce it, considerations must be given by him to the promissor or some other person at the promissor's request. These, said his Lordship, were well-established principles of law in this country.

"Either of the principles seems at first sight fatal to the defendants' contentions. They were not ostensible or disclosed parties to the bill of lading. That they discharged the cargo was unknown to plaintiffs. It is quite impossible to say that Scruttons Ltd. were ever in any contractual relations with plaintiffs as undisclosed principals of the United States Lines Company."

Defendants had contended that there was an exception to these principles as enunciated by Lord Justice Scrutton, namely that where there is a contract with an exemption clause the servants or agents who act under that contract have the benefit of the exemption clause.

This, which Lord Justice Scrutton had described as the effect of a case decided by the House of Lords, was obiter. If the House of Lords really did lay down this principle of "vicarious immunity from liability for torts," it disposed of the present case in defendant's favour.

"While I think that Lord Justice Scrutton's dictum adequately reflects his own view, I cannot accept that it represents the majority view of the House of Lords. In my opinion that case was no authority for the principle of vicarious immunity and Lord Justice Scrutton incorrectly stated its effect."

On the question of whether there could be an implied contract between Messrs. Scruttons and plaintiffs, his Lordship said plaintiffs never invited Messrs. Scruttons to do anything to their goods. They only applied to Messrs. Scruttons for delivery of the goods. It was the United States Lines Company who asked Messrs. Scruttons to handle the goods and they did so with the object of performing through Messrs. Scruttons their own contract with plaintiffs.

Defendants had insisted that they were sub-bailees of the goods when they were damaged. His Lordship took this to mean that the United States Lines Company, being in possession, transferred to Scruttons Ltd. such exclusive right of possession as would have entitled them to be prosecuted for larceny as bailees if they had stolen the goods.

"I doubt whether Messrs. Scruttons were ever sub-bailees of the goods but as any possession they had was given by the United States Lines Company and not by plaintiffs, it seems quite immaterial."

His Lordship referred to a recent statement of general principle by Lord Denning who said that a man who makes a promise which is intended to be binding must keep his promise and the court will hold him to it even at the suit of one who was not a party to the promise, providing he had sufficient interest to entitle him to enforce it.

(Concluded on foot of following page)

Mechanisation in U.K. Ports

A few of their problems

By a Correspondent

There is a danger that United Kingdom ports will acquire an inferiority complex on mechanisation unless the progress they have made since 1945, and the difficulties that many still face, are more widely appreciated. Constantly drawing attention to the swollen tonnages achieved on repetitive traffic, through the more general use of fork-lift trucks, takes on the appearance of special pleading, particularly to those who still struggle with the many problems posed by mixed general cargo ships. To read that the average output in British ports is approximately 6—8 tons per gang hour is meaningless; its repetition is a mere irritant. Experienced port operators know that statistics of this kind can have value only when they are examined within such categories of cargo as homogeneous, mixed Continental, Far East, Australian and others. Comparison has no value unless it is made for similar working conditions. The average figure that has been quoted presumably takes into account work at the 91 British ports that are within the National Dock Labour Board's scheme. Where is the value to any port, of averaging the outputs under the widely different conditions at Millwall Dock and Mousehole or Manchester and Maryport?

It is gratifying to know that in the Great Lakes area of Canada trucking and palletisation are well advanced; but for the output recently quoted of 166.6 tons per hour loaded there, a search into conditions and the nature of the ships and their cargo is called for. Comparing outturns is rarely a profitable occupation. An economist studying the outturn of, let us say, a biscuit factory in Carlisle with one in Swindon, would find that, basically, the operations in both follow closely the same trend; both factories are modern and they produce approximately the same range of articles. If he then turned his mind to the outturn of two ports he would immediately discover that there were different customs, a different division of responsibility for the work, one port was old and the other practically rebuilt since the Second War, one was a crane port with a high proportion of all cargoes landed, the other almost entirely a seasonal and overside port. In very few ways would he find that methods and cargoes were alike.

The lack of comparable material is not confined to dock operations. Brave attempts have been made from time to time to cut through the jungle of dues, charges and tariffs in an attempt to prove that A is a cheaper port than B. Only a port of the size of Haifa has ever succeeded in producing a worthwhile index to port productivity. Tonnage handled per foot-run of quays is not a generally satisfactory method of comparing port efficiency. At the risk of repetition, a comparison must, therefore, be between strict like and like, not like and unlike. It is on this rock that attempts to extract a value from comparative outputs have consistently foundered. To say that the inferior output could be improved overnight by the use of additional mechanical aids is an over-simplification.

Improving output is, nevertheless, a fascinating study. It is, and has for some years been engaging the best brains in the port industry. Since 1945 the urgent need to handle increased tonnages, made up, in the main, of units of increased weight, has led, by means of the hard way of trial and error, to the discovery of certain basic principles of mechanisation. It is not one of these that outputs are increased in proportion to the number of machines that can be induced to work within the area—a view that had steadily to be combated during the early years of mechanisation.

What then are the essential conditions that must be diligently sought, in any scheme for improved outputs? Surely the first is that the machine selected for the job will do it more efficiently than it is at present being done. Secondly, that within a measurable time from the purchase of the machine, the savings its use has made possible will be greater than its cost, plus the cost of renewal in the not distant future. These savings may not be confined to the direct use of the machine. Thirdly, that the continued use of the equipment will more than offset the cost of maintenance. Fourthly, and this is to take a longer view, that the machine will confer on the user a prestige that will attract new business.

The practical man will amplify these conditions by referring to the need for a simple system of spares and the possibility of using the machine on other than the particular business for which it has been bought. He will have one eye on the hidden costs that so easily attach themselves to new ventures and so quickly become accepted as essential services. " What I saved at the ship's side I lost in the garage " is as true to-day as when it formed the sad reflection of a disillusioned pioneer in the 1940's.

Difficulties that face Ports

If, then, there is a general desire by the main employers of dock labour, i.e. the port authorities, shipping companies and master stevedores, to introduce mechanisation into their respective spheres what is stopping so commendable a process? Is the impression to be gained from recent articles on this subject altogether the correct one? Are the ports in this country still worked by interests who are ignorant of the lucent merits that the simpler forms of mechanical equipment possess? Is it merely failure to accept the assertion that labour saving devices, when used in sufficient quantity, can bring our English outputs within the range of Canadian achievements, that is permitting ports abroad—so we are told—to draw ahead?

In the first place, British port authorities have spent vast sums since 1945 on mechanisation. Without guidance, save the little knowledge gained under unreal war conditions, they embarked on major schemes. They took advantage of war damage to construct premises of original design but suitable for the new methods. Large scale experiments have been made with mobile cranes, fork-lift trucks and other items of equipment (built originally for factory and depot use), so as to discover types that would be suitable for the highly specialised usages of dockland. To maintain the units eventually purchased in sound working condition extensive new garages and repair shops have been built, equipped and manned.

In the realisation of any brave new world there are limits which must be accepted. In no two ports is the problem the same. Seldom in two ports are the powers and responsibilities of

Litigation in the Port Industry

(Concluded from page 31)

Assuming that the limitation of liability in the bill of lading was made for their benefit, the question still remained as to whether Messrs. Scruttons had sufficient interest to enable them to enforce it.

However, these observations by Lord Denning were obiter, and in direct conflict with other cases binding upon his Lordship. Even if he was satisfied that the bill of lading was made expressly or impliedly for the benefit of Messrs. Scruttons he would not have followed these statements.

" I think the present case is governed by simpler and old-fashioned principles and that defendants cannot limit their liability to plaintiffs in tort by relying on a contract between plaintiffs and a third party, to which they were not parties and for which they gave no consideration."

His Lordship gave judgment for plaintiffs for £593 12s. 2d., with 4 per cent. interest from May, 1957, and costs.

port authorities the same. The loading and discharging of cargo across the quays involves the action of transport workers in at least four separate locations—the receiving or delivery of goods from, or to, road or rail at the rear of the shed, the sorting and piling within the shed, the trucking-out for shipping-off or the receiving and taking into the shed. Finally, the reception and stowing within the hold, or the breaking out and despatch of the cargo from the hold. Where, as in Manchester, the whole of the operations (including that of tallying the cargo) is performed by one authority, a high standard of mechanisation has been reached. Where there may be at least two employers (and in many cases, two unions) as in London, the well meant efforts of the port authority call for complete reciprocation before 100 per cent. mechanisation can be realised.

Again, is it fair to compare the handling of cargoes that hardly vary from one year to another in the weight and size of the units composing them, with the infinite variety of general cargo that passes through a port where the wants of civilised peoples from all over the world are satisfied? Is it a simple matter to select machines that for an hour may handle bales of plywood, after which they must be adapted for ingots of metal, drums of cable, bundles of steel rods or outsize exports? Where is the profit in providing machines that are continuously put out of action because the receiver suddenly elects to take his goods directly overside into barge? In every port there is a different norm of overside deliveries. Whilst this may remain constant over the years, and be accepted as a factor affecting the work, the Bills of Lading of which the total is composed, are not predictable as to their destination from day to day. Dislocation of labour—and of labour saving devices—through last minute alterations in the disposal of cargo, is a daily occurrence; such happenings are calculated effectively to damp enthusiasm for mechanical alternatives to present practices.

Seasonal Traffic

A great deal of the traffic that passes through a port may be seasonal in character. It is not difficult to purchase equipment, either fixed or mobile, that is a tailor-made job when applied to this one traffic. What is difficult is to design equipment that will handle seasonal traffic adequately and yet be available for general cargo, possibly in another part of the port, and under entirely different conditions, during the remainder of the year. Fork-lift trucks and mobile cranes must have contrived for them an economic usage which should be around eight hours a day. Sustained usage of this degree has to be contrived, in the face of division of responsibility, customs of the port and the nature of the traffic. If it is an unassailable port custom for receivers to provide their own labour to take delivery of their cargo, how is the turn-round of ships expedited if the authority, who receive the goods ashore, pile these roof-high? Is every occasional lorry owner who applies, say, for a few reels of paper, expected to bring his own fork-lift truck so that he may dig out picked numbers? Is he to be mulcted with the hire of a truck and driver from the authority who have skied his cargo, in the sacred name of mechanisation?

Individual cartage agents cannot afford such outgoings. The larger employer, such as the master stevedore, is, however, expected to equip himself with a range of machines to meet the constant changes in the cargoes he handles. It is true that many of the larger employers have mechanised part of their work; this has been done within the limits set by the operations and the cargo, the construction of their vessels and the possibilities for economical use.

Out of Date Premises

What good can come from attempting mechanisation in premises designed for manual working? The least flexible of all the instruments of productivity, the docks in many ports date from the end of the eighteenth or the beginning of the nineteenth century. Whilst full advantage has been taken of war damage to erect sheds and warehouses that will permit mechanised working, a high proportion of port premises still inhibit modern methods. Construction was originally based on unlimited labour and hand trucks " Quant. suff." Premises followed designs that were basically unlike those required for fork-lift trucks, mobile cranes and conveyors. This heart-breaking problem has been crystallised by Sir Leslie Ford in a recent reference to the Port of London Authority's attitude on new works; " to avoid the mistake of their predecessors, the private dock companies, who, seemingly building for eternity, eventually made posterity their prisoners."

Whilst organised port labour has observed the national agreement made in the early 1920's (which governs the introduction of mechanised practices), this does not mean that a proposed turnover from manual handling is always timely. Despite the record tonnages that have passed across the quays in this country since 1945 it is well known that there have been long periods when the supply of labour has been in excess of the demand. The enthusiasm for new methods that can be counted on from both sides, when labour is hard to come by, is apt to flag when men can be had for the asking.

Problems facing Shipping Companies

What of the problem of mechanisation in the ship? There are, to-day, many experts who are willing and anxious to improve handling on the quay. Their efforts must wait, however, on the design that the ship of the immediate future will take. Hardly a shipping company but is faced to-day with a decision as serious in its way as the earlier change from sail to steam. The president of a line noted for its bold adventures in cargo handling was reported recently as saying " I am sorry in a sense that we have to come up to our shipbuilding programme now. I am sorry we can't wait ten years, because by that time I am sure enough people will have tried it and will have gone broke . . . or will have worked out the bugs so that we shall be able . . . to take advantage of experience. We are not in that position. We have to face the issue to-day. I would be very nervous to-day as a common carrier building a general cargo ship, that if we built a conventional ship, ten years from now it would be either commercially non-competitive or obsolete . . . I don't like the problems that we are faced with. They are hideous."

In face of this down-to-earth statement who would advise the premature purchase of equipment until it is known whether the ship will be loaded through end-doors, side-ports, hinged hatches or by the familiar hook? It is understandable that until the shape of things to come is more precise in the ship mechanisation must lag on the quay.

When the history of these present times is written, high tribute should be paid to port employers whose faith in the then untried machines led them to invest terrifyingly large sums in enterprises, the outcome of which could hardly be predicted. Now that mechanisation has come to stay it is not difficult to prescribe larger doses of the mixture. The fact remains that mechanical equipment costs a great deal of money to buy and a great deal more to maintain and, eventually, to replace. Hard economic facts will always determine the extent to which individual employers can participate in new methods. Those who, for reasons that appear good to them, have refrained from mechanisation will find competition becoming increasingly fierce. Conditions in the port industry are so complex that the problem will hardly be solved by such simple expedients as increasing the number of trucks in use.

The Port of Workington

A Review of the Workington Harbour and Dock Company, Limited

As long ago as 1566, Workington was regarded as the chief seaport in Cumberland and its maritime associations can be traced back for several centuries earlier than that in coastal trade between Scotland, Ireland and the Isle of Man.

Situated at the mouth of the River Derwent, on the east side of the Solway Firth, its modern development originated with the Acts of Parliament of 1861 and 1863, which empowered the Earl of Lonsdale to construct a dock at the north-west entrance of the harbour. This work was completed in 1865 when the Lonsdale Dock was opened to vessels of up to 2,000 tons.

In 1900, the Workington Railways and Dock Company was formed to acquire both the harbour and the Lonsdale Dock, and five years later the property passed into the hands of the Workington Harbour and Dock Board. With the growth of traffic in coal and steel, it was apparent by the end of the First World War that the facilities were now inadequate. In 1918, Workington Iron and Steel Company was acquired by the United Steel Companies Limited, and as the steelworks had for many years been the major user of the port, United Steel decided to seek further parliamentary powers for the widening and deepening of the Lonsdale Dock and the conferring of additional financial and other powers on the Harbour and Dock Board. This led to the Workington Harbour and Dock Act of 1920, and work began on the improvement and extension of the Lonsdale Dock in 1922.

The newly-constructed dock was opened by the Prince of Wales on June 30th, 1927, and was renamed the Prince of Wales Dock. About £650,000 was spent on this development project, which enabled the dock to accommodate 10,000-ton vessels and to provide adequate, modern equipment for loading and unloading. Since that time, all the seaborne traffic of United Steel's Cumberland works—the Workington Iron and Steel Company and Distington Engineering Company, Limited—has been handled by the dock. Under the most recent legislation, control of the dock passed to the Workington Harbour and Dock Company, Limited, on January 1st, 1958. This is now a controlled statutory undertaking, wholly owned by The United Steel Companies.

As Table 1 shows, exports of coal have declined drastically from the pre-war level and are now a small part of the total trade. On the other hand, exports of pig iron and of steel in the form of railway materials, such as rails, fishplates and sleepers, and imports of iron ore have shown a steady increase, temporarily disturbed last year because of the lower level of activity prevailing generally throughout the iron and steel industry. The "miscellaneous" traffic includes petroleum, coking coal and bricks on the import side, and exports of ingot moulds, coke nuts, tar and pitch. Petroleum imports, totalling 46,503 tons in 1958, are conveyed by pipeline to the storage depot of Shell-Mex and B.P. Limited, which was opened in 1954 and is adjacent to the harbour area. A total of 489 vessels with an aggregate of 306,483 net registered tonnage visited the port last year.

The dock itself is 982-ft. long, 320-ft. across at its widest point and can accommodate vessels up to 450-ft. long and 58-ft. beam. The dock entrance is 70-ft. wide, the depth on the dock sill being a minimum of 23-ft. 6-in. at neap tides and a maximum of 33-ft. 6-in. at spring tides.

When the dock was reconstructed in 1927, six 5-ton electric cranes were installed; in 1950, two 7-ton cranes were added and last year a new 10-ton crane came into operation. At the present time, a second 10-ton crane is on order, which will be equipped with dual drum control. These cranes can each unload at least 800 tons of iron ore per day or load 700 tons of steel. The handling facilities also include a 25-ton Scotch derrick electric crane and two electrically-operated belt conveyors, each capable of transporting up to 800 tons of coal per hour.

A modern 900 h.p. steam tug was acquired after the war as well as a dredger, which was specially designed and built for the port. The dredger removes between 225,000 and 250,000 tons of silt a year in order to keep the channel clear. Considerable attention has been paid to the silting problem and a tidal model was constructed in order to aid the investigations. The theoretical work has now been completed and the findings are at present being studied.

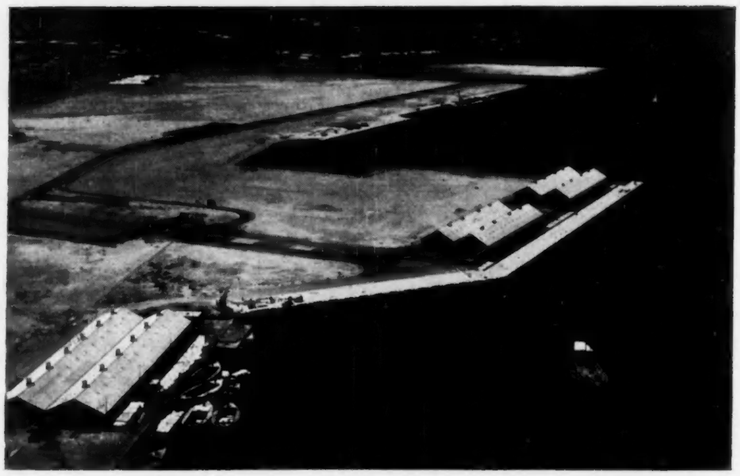
An amenity building for dock workers, built in 1956, contains a canteen, washing facilities and an ambulance room; the latter is believed to be one of the best-equipped in the country. The washing unit in the amenity centre was provided by the National Dock Labour Board. The dock offices and shipping department were extensively modernised in 1958, the accommoda-

TABLE I

Summary of Traffic Handled by the Port of Workington.

Imports (tons)	*1938*	*1948*	*1957*	*1958*
Foreign ore ...	350,151	476,049	672,244	473,952
Miscellaneous ...	50,558	13,472	78,657	111,970
Total imports ...	400,699	489,521	750,901	585,922
Exports (tons)				
Steel and pig iron	64,291	48,518	96,349	81,404
Coal	190,500	39,709	7,511	4,195
Miscellaneous ..	23,672	12,848	38,539	22,039
Total exports ...	278,463	101,075	142,399	107,638
GRAND TOTAL	679,162	590,596	893,300	693,560

Two views showing cranes, ore handling facilities and shipping at Prince of Wales Dock, Port of Workington.



Aerial view of Workington Dock showing tank farm on left and tidal harbour on right.

tion including offices for the secretary and manager of the Harbour and Dock Company, Mr. J. Z. Bridgewater, and the harbour and dock master, Capt. J. Thompson.

In addition to the dock—and indeed its historical predecessor—there is a tidal harbour, which still deals with a number of fishing vessels and other small craft. The depth of water in the harbour is roughly 10-ft. less than on the dock sill, a swing bridge over the Derwent and the harbour providing access to the nearby works of Workington and Distington. There is also a direct connection from the harbour and the dock to the main lines of British Railways.

In view of the continuing programme of modernisation and development at the two main local plants — Workington, for example, have recently started to erect a new £2½ million sinter plant—it is reasonable to assume that the port will maintain its pre-eminent position among the four Cumberland ports and will handle an increasing volume of foreign and coastal traffic in the years that lie ahead.

Manufacturers' Announcements

Radar for Small Craft

A new low-power radar equipment, the "Consort," has been designed by the Marconi International Marine Communication Co. Ltd., for use in small vessels where space and electrical power are limited. The new equipment is suitable for tugs and harbour craft of all types, fishing and pilot vessels, lifeboats and yachts and its introduction open up a new field of application for marine radar equipment. Port services are largely maintained by small craft, and the disruption of these services by fog can delay the sailing of larger vessels equipped with every modern aid to navigation. By helping small craft to maintain these essential services during bad visibility "Consort" will prove of value to everyone concerned.

The equipment comprises a display unit, transceiver and aerial; the use of transistors, printed circuits and new manufacturing techniques having resulted in an extremely compact installation. It operates from a 24-volts battery or by conversion from other voltages, and has a maximum range of 14 miles which is ample for the needs of small craft.

The display unit is designed for mounting on a deckhead, bulkhead or table. A 5-in. cathode ray tube is employed, and a magnifying lens incorporated in the detachable visor increases the effective diameter of the display to 8-in.

Two minutes after switching on, the "Consort" reaches a "stand by" condition, and it is then ready for immediate use. A "press-to-view" switch is provided on the display unit, and when this is depressed the scanner starts and the equipment becomes fully operational for two minutes. It will then revert to the "stand by" condition until the "press-to-view" switch is again depressed; but this switch can be overridden to provide continuous viewing when necessary. This arrangement reduces battery consumption.

The tubular case of the display unit is sealed with rubber gaskets to give a strong and watertight assembly, and hand grips are fitted on the mounting bracket to enable the observer to steady himself when using the equipment in bad weather. The whole assembly measures 14½-in. x 11-in. x 25-in. long including the detachable visor, and weighs only 14 lb.

Operator looking through the display unit of the Marconi Marine "Consort" small craft radar, installed on the deckhead.

The transceiver is housed in a compact steel cabinet and can be fitted in the smallest wheelhouse. A panel on the front of the transceiver carries the range selector switch, a brilliance control for the range rings, and gain, sea clutter and rain clutter controls. Five ranges are provided, covering 0.6, 1.5, 4.0, 8.0 and 14.0 miles.

The scanner assembly incorporates a 3-ft. slotted waveguide aerial in a waterproof fibreglass radome, which is designed for mounting directly on the roof of a small wheelhouse, but if extra height is needed to clear obstructions, a light alloy tripod mast can be supplied.

New Series of Mobile Cranes

The range of Jones mobile cranes manufactured at the Letchworth works of K. and L. Steelfounders & Engineers, Limited, has been extended to include three 20-ton models, a KL12-20M self-propelled unit, a KL12-20L lorry-mounted crane and a KL12-20R rail bogie crane. Straight diesel-mechanical transmission system common to all Jones cranes has been retained on the grounds of its reliability and efficiency. The general arrangement of machinery on the slewing superstructure also follows the established Jones practice of unit construction. The individual crane motions are separate and self-contained, being mounted in a well-spaced arrangement that provides excellent accessibility for servicing and at the same time ensures a low overall height giving the driver a wide field of vision. On British Standard ratings the crane lifts 20 tons with outriggers extended or 12 tons free on wheels, in both cases at 10-ft. radius. At 30-ft. radius the corresponding load ratings are 4 tons and 2½ tons.

The KL12-20M self-propelled mobile crane chassis is mounted on 14.00-in. x 24-in. heavy-duty pneumatic tyres fitted with the usual Jones restrictor wheels. Two-wheel drive is the standard arrangement but four-wheel drive is available as an alter-

native. For travelling duties there are four-wheel hydraulic brakes, air assisted; in addition a hand lever with mechanical linkage is provided for parking purposes.

To meet the demand for higher travelling speeds this crane has been designed to travel at 8 m.p.h. When carrying full load the maximum recommended travelling speed is 2 m.p.h.

Slewing motion is fitted with reversing plate clutches. Hydraulic controls provide sensitive operation at speeds up to 2½ r.p.m. of the superstructure, and an automatic brake is fitted. Additionally a positive lock is provided to prevent accidental slewing when the crane is in transit.

The standard power unit for this crane is the Perkins Four 270 D direct-injection diesel engine developing 62.5 b.h.p.; 12-volt electric starting equipment is fitted and cooling is thermostatically controlled.

The standard jib is of tubular steel, straight lattice construction, 30-ft. in length, in two sections. By the insertion of 20-ft. intermediate sections the length can be extended to 50-ft., 70-ft. or 90-ft., as required.

The lorry-mounted crane, KL12-20L, incorporates the KL12-20 slewing superstructure, this being mounted on a modified Foden six-wheeled crane carrier chassis. This chassis is powered by the Gardner 6LX 150 b.h.p. oil engine and is equipped with a five-speed gearbox; it is capable of road speeds up to 20 m.p.h. Performance (except as to speed) is similar to that of the KL12-20M model, except that maximum permitted load free on wheels is 10 tons.

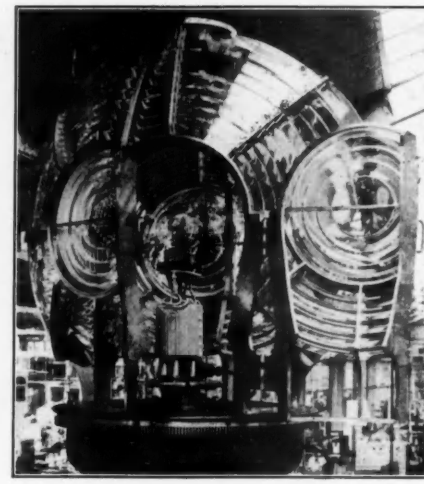
The standard railway model is designed for 4-ft. 8½-in. or alternative gauges. The rail carriage is mounted on eight wheels in two bogies, all wheels driven, and the crane will traverse curves down to 80-ft. radius. The bogies are spring mounted, with spring locks for lifting duties. Brakes are fitted on all four axles, actuated from the driver's cab.

Jones KL12-20M mobile crane.

New Lighthouse Equipment for India

Stone-Chance Limited, a member firm of Stone-Platt Industries Limited have recently supplied to the Indian Lighthouse Service two complete installations for the modernisation of Jakhau and Jegri Lighthouses. Both lighthouses are on the West Coast of India, near the Pakistan border—Jakhau between the Gulf of Kutch and Cori Creek and the other on Jegri island in the district of Kathiawar.

The equipment in each case is basically similar and includes an optic which revolves by weight-clock mechanism on a mercury float pedestal, housed in a glazed cast-iron lantern with copper roofing. The lightsources are 100 volt lamps (Jakhau 1,500 and Jegri 1,000 volts). Lamp exchangers are fitted to bring standby lamps into focus in 1½ seconds should the main lamp fail. Jakhau will transmit a single flash of 2,260,000 candelas intensity every 10 seconds, Jegri a group of 2 flashes every 20 seconds, the beam intensity being 1,670,000 candelas. Emergency illumination is provided in both cases by oil-mantel burners.



The new optic for Jegri Island with one panel opened to show the automatic lamp exchanger.

Since no main power exists at these sites, Stone-Chance have supplied both with their triplicate automatic generating plant. Each plant consists of three diesel engine alternator sets, the second and third being standby to the first.

Radar for New York Ferry Service

A contract, obtained in open competition with American radar manufacturers, has been awarded to Decca Radar Ltd., London, by the New York City Department of Marine and Aviation for the installation of 14 Type D 303 radars in seven double-ended municipal ferry boats operating between Brooklyn and Staten Island. Maintaining a 24 hours continuous service across the Narrows of New York harbour, these ferries operate directly across the main shipping lanes and through 2 anchorages and carry over two million passengers and two and a half million vehicles yearly. This order follows a contract already placed by the New York Fire Department for the Decca type 214 River Radar, seven sets of which have already been supplied.